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ABSTRACT

Presented is the fifth formative evaluation report on "Me and My Environment," a 3-year environmental sciences program developed for 13-to 16-year old educable mentally handicapped (EMH) children by the Biological Sciences Curriculum Study (BSCS). The first half of the document consists of samples of student performance on specific assessment items from one curriculum unit (on "transfer of cycling materials") field tested with 482 Ss and a second unit (on "air and water") tested with 110 Ss. Described next are the development of a sound-filmstrip and results of a mini-field test of a game focusing on recycling. Explained in the final section is the BSCS systems design approach to analyzing the development of a curriculum package for EMH students. Flow charts illustrated 12 stages in the systems approach from planning the curriculum framework to final revisions. In the summary it is noted that most Ss evaluated with the materials were capable of achieving the objectives set forth at an acceptable level. (LS)

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ME AND MY ENVIRONMENT

FORMATIVE EVALUATION REPORT

5

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The Curriculum

ME AND MY ENVIRONMENT[1] is a three-year environmental sciences program developed specifically for 13- to 16-year-old educable mentally handicapped (EMH) children by the Biological Sciences Curriculum Study (BSCS). Its development and assessment, the actual materials and their use in the classroom, the approaches to data collection, and the student outcomes all merit evaluative study. Such activities might best be viewed in the context of the three-year timeline for the development, testing, and final commercial release of the first two-year sequence (Units 1-3) of the program. During this period the third-year (Units 4 and 5) sequence was developed and tested, with an additional year and a half devoted to the final evaluation and revision for commercial release.

So that ME AND MY ENVIRONMENT could be used in special education classes as soon as possible, the field trials were designed to overlap; two complete field tests of the materials were accomplished in three school years.

The materials for ME AND MY ENVIRONMENT include a series of teacher's manuals that suggest specific teaching strategies for each activity. Also included is a kit of all equipment, media, and supplies that are required for the instructional program, but not usually available in special education classrooms. There is no student text, for the program is designed around activities that are conducted by the students themselves; these activities are supported by a variety of materials in a number of different media designed to appeal to two or more different senses of the students. These materials, in addition to science equipment in the kit, consist of

35mm slides, filmstrips, cassette tapes, individual student worksheets, games, posters, study cards, wall charts, illustrated booklets, and evaluative devices. The program makes use of a 35mm slide projector and an overhead projector. In addition, the students' direct involvement with a Polaroid camera and a cassette tape recorder has been tested.

A reader of this report who has more than a casual interest in the BSCS program will likely have reviewed, or have access to, the teacher's manuals for ME AND MY ENVIRONMENT. For this reason, information on the curriculum objectives, science content, and skill development will not be given here. (Refer to the front material in any unit of the manuals for this information.)

The development of this project and its evaluation are based upon three years of experience in developing and field-testing ME NOW, a life science curriculum for 11- to 13-year-old EMH children.[2] The ME NOW program and the first two and one-half years of ME AND MY ENVIRONMENT are now available in commercial editions from Hubbard Scientific Company, Box 105, Northbrook, Illinois, 60062. Several evaluation reports on these programs have been prepared. (See references 3, 4, 5, 6, 7, and 8 at the end of this section.)

The Evaluation

Because the evaluation effort for this program is truly formative—an assessment designed to direct revision—the information gathered is utilized by the developers whenever the material that has been tested is revised. One might think, therefore, that there is little point in preparing formal evaluation reports based on this formative data. Yet the experience gained and some of the outcomes of the evaluation have been found to have value to other audiences. Such information is judged not only worth preserving, but also of a sufficiently general application that the timelines of reporting it become a concern. It was decided, therefore, to issue a series of interim evaluation reports. Several cautions to the reader of these interim reports are necessary in order to avoid misinterpretations of the findings.

1. The interim reports document results with experimental materials, and therefore do not present a balanced view of the program finally released for commercial publication.
2. The interim reports identify some of the changes to be made, but do not reflect all the changes incorporated into revised materials.
3. The interim reports discuss specific aspects of the experimental program and therefore do not provide a synthesis of the entire program.

A description of the contents of the first three ME AND MY ENVIRONMENT reports in this series is given on page 3 of *Formative Evaluation Report 3*. The fourth report described the standards for judging the success of instruction and of the materials, and presented a new approach to the assessment of student performance. Additionally, it reported on student performance related to instruction in a second series of field tests of revised Units 1, 2, and 3, and compared the results to those of the first trials. Only a limited number of copies of this report were printed, but copies are on file at all special education instructional materials centers and are available from the Educational Resources Information Center (ERIC) networks Document Reproduction Service (EDRS).[9] Abstracts have been published by the CEC Information Center in its capacity as the ERIC Clearinghouse on Handicapped and Gifted Children.[10]

This report, *Formative Evaluation Report 5*, serves to present samples of student performance related to instruction for the third year of the program, as reflected in the first and second editions of Unit 4 and the first edition of Unit 5. It also presents the results of a mini-field test, the development of a typical piece of media, and describes the BSCS process, of which this formative evaluation is an essential part.

References

[1] *ME AND MY ENVIRONMENT (Life Sciences: A Special Education Program). Unit 1: Exploring My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1974.

———. *Unit 2: Me as an Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1974.

———. *Unit 3. Energy Relationships in My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1975.

———. *Unit 4: Transfer and Cycling of Materials in My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1976.

———. *Unit 5: Air and Water in My Environment.* Boulder, Colorado: Biological Sciences Curriculum Study. 1973 (Second Experimental Edition).

[2] *ME NOW, Life Sciences: A Special Education Program.* Boulder, Colorado: Biological Sciences Curriculum Study. 1972.

[3] Steele, Joe M. *Arranging Field Tests: Characteristics of Sites and Students. ME AND MY ENVIRONMENT Formative Evaluation Report 1.* Boulder, Colorado: Biological Sciences Curriculum Study. June 1973. 29 pp. (ED 087190) (EC 061292)

[4] ———. *Assessing Student Abilities and Performance: Year 1. ME AND MY ENVIRONMENT Formative Evaluation Report 2.* Boulder, Colorado: Biological Sciences Curriculum Study. December 1973. 48 pp. (ED 087191) (EC 061293)

[5] ———. *Design and Revision, Data Collection and Portrayal. ME AND MY ENVIRONMENT Formative Evaluation Report 3.* Boulder, Colorado: Biological Sciences Curriculum Study. September 1974. 53 pp. (ED 100123) (EC 071063)

[6] Gromme, Roy O. *Assessing Student Abilities and Performance: Year 2. ME AND MY ENVIRONMENT Formative Evaluation Report 4.* Boulder, Colorado: Biological Sciences Curriculum Study. May 1975. 32 pp. (ED 112623) (EC 080112)

[7] Robinson, James T., and Richard R. Tolman. *A Formative Evaluation of ME NOW, Unit 1, Digestion and Circulation.* Boulder, Colorado: Biological Sciences Curriculum Study. September 1970. 97 pp. (ED 043182) (EC 030165)

[8] Tolman, Richard R. *A Formative Evaluation of ME NOW, Life Sciences for the Educable Mentally Handicapped, Final Report.* Boulder, Colorado: Biological Sciences Curriculum Study. December 1972. 305 pp. (ED 071263) (EC 050871)

[9] ERIC Document Reproduction Service, P. O. Box 190, Arlington, Virginia, 22210.

[10] CEC Information Center, 1920 Association Drive, Reston, Virginia, 22091.

student performance on items assessing instruction in unit 4, "transfer and cycling of materials in my environment," field tests I and II

For Field Test I, seventy-five items assessed curriculum materials and instruction in the twenty-nine activities of Unit 4, "Transfer and Cycling of Materials in My Environment," experimental edition 1972-73.

In the 1973-74 experimental edition used for Field Test II, seventy-five items were used. These were distributed over twenty-eight activities, however, rather than the previous twenty-nine.

As with previous units, data for evaluation purposes were collected from "Clues to Success" activities that were incorporated in each unit. These activities were administered at various intervals immediately following instruction.

The population from which data were analyzed for Field Test I consisted of fourteen classes containing 198 EMH students. The Field Test II population consisted of fourteen classes containing 284 EMH students. For certain items, because of student absenteeism in some cases and disqualification of data in others, the population was considerably less than indicated above. Data were disqualified when, in the judgment of the BSCS staff, it appeared that certain teachers provided too much direction to their students, and as a result, nearly every student responded to the assessments in the same way.

Twenty of the seventy-five items remained essentially the same in the second edition, which allows for comparison of student performance in Field Test I and Field Test II. The twenty items assessed materials and instruction presented in the activities of the unit, and the items were divided into three categories by topic: (1) the transfer of energy through an environmental system; (2) the role of microbes and other decomposers; and (3) the process of recycling materials in finite supply. Although the results are presented by these content topics, the items were interpreted separately rather than as subtest totals.

Results are presented with a brief discussion of each item, the percentage of students who responded successfully, a comparison with established standards as previously discussed, and a comparison between the two field tests of the assessments. A brief analysis is also provided as an explanation of revisions and expansions and/or deletions that took place in the final program as a result of student performance on the assessments.

In earlier studies on the precedent curriculum, ME NOW, the percentage of successful responses on the test items was characteristically at the 50-percent level. In that study, many students had reasonable and logical explanations for choosing options other than the intended answers to many items; hence, the level of understanding was not totally reflected in the percentage of students who chose the "right" answer. In fact, many of the test items have been scored with a qualitative scoring key, where some responses are given credit for being partially correct. For example, four different kinds of trucks were pictured in one item that asked which truck worked most like the stomach; students who chose the tank truck or pickup truck instead of the cement mixing truck reported in later interviews that those trucks "carried things like the stomach carries food." The reasons for choosing other "answers" provide a separate justification for inspecting each item independently.

Similar results were recorded for the ME AND MY ENVIRONMENT assessment. In fact, 40 percent of the Unit 1 test items have a qualitative scoring key, with some responses given credit as partially correct. The reasons for choosing other "answers" provide a separate justification for inspecting each item separately.

The problem of assessing the learning of EMH students is not resolved by producing an "achievement test," since the question of what standard to apply to performance on these items or subtests is one that is difficult to answer. It is unrealistic to expect all children to be able to answer all items, when a wide range of difficulty and a range of topics are involved. Answering successfully even one or two items more on Field Test II than on Field Test I may represent considerably improved materials and, therefore, significantly more learning for some students. The items represent the staff's judgment of key content that should be learned, *not* all learning that can be expected to occur in instruction. Some areas of learning were not assessed at all; others were explored only through interviews and are not reported here. Students' attitudes also are not reflected here, although such measures are reported in the previous Report. The effects of this curriculum on self-confidence, social participation, task orientation, and general response to school have not been formally assessed.

Efforts were made from the beginning to assure that use of the items in different classes would be comparable. The "Clues to Success" activities were administered by the teachers, using identical instructions. Training was provided at the beginning of the school year, and additional written instructions were provided. Even with these precautions, however, conditions and procedures could not be completely standardized.

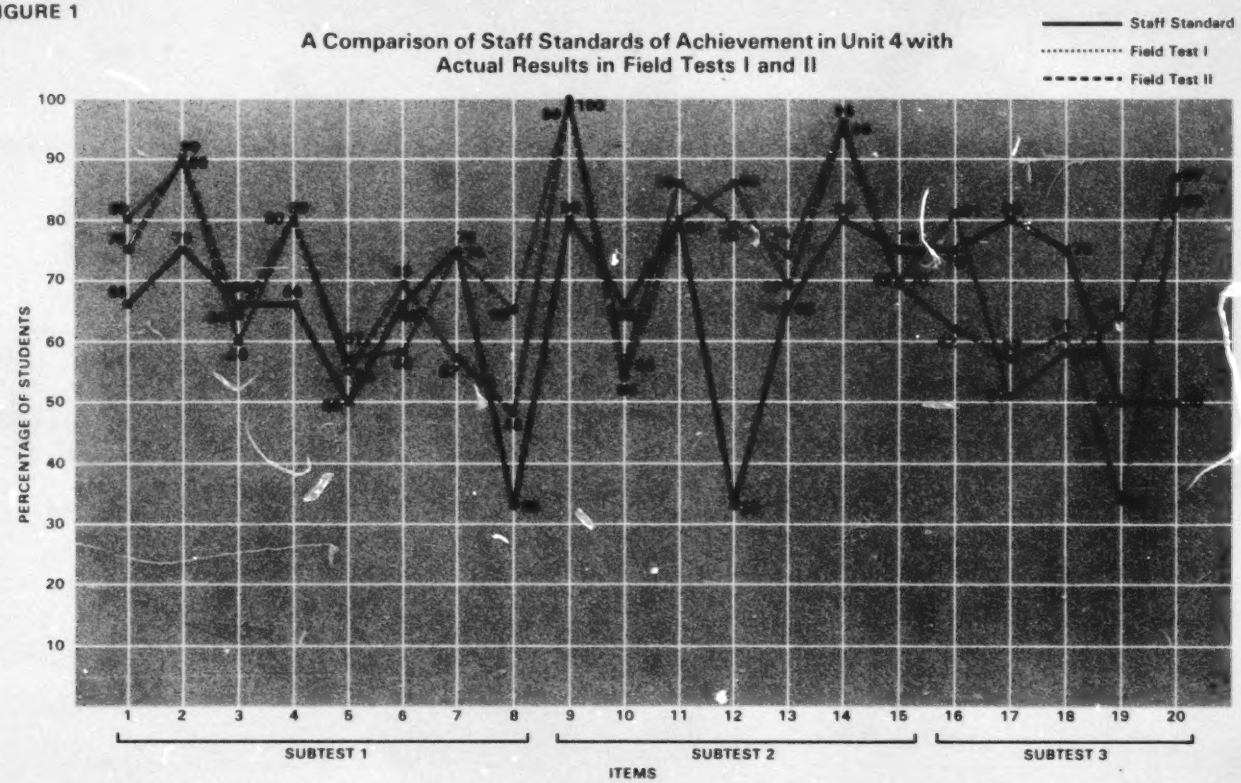
It should be noted that student performance on these selected assessments was only one vehicle used in evaluating the ME AND MY ENVIRONMENT curriculum materials. Student interviews, teacher ratings, independent evaluation, and classroom observations were all used extensively to provide additional information for the curriculum developers.

These test items represent the best judgment of the staff as to key concepts to be learned in the materials. Even though the results should not be used as a summative evaluation of student learning, they do provide a clue to the degree of learning that occurred. When these results are combined with information on the functional abilities of this population, the expectations of student response to the materials can be readjusted, and revisions can thus be designed to enhance further learning.

Prior to field-testing, the staff established standards of acceptable student performance for the various objectives and assessments. In some cases these standards were based on hard data, but often they were intuitively based on such factors as a general knowledge of the population, the importance of the item, and the experience of a normal population of students with similar items. (See Figure 1.)

Some of the items assess learning that goes beyond the achievement of minimal objectives. Since the curriculum is designed to allow the students in a typical EMH group to progress as far beyond the minimal standards as possible, some items were meant to assess what learning took place above that minimum. Hence, the performance standards vary from 33 percent up to 80 percent. Upon studying the reliability and other analysis factors of the items, the staff compared the standard to the actual achievement and sought answers to the questions thus raised. The item was analyzed for clarity or unwanted cues; it was examined to see if it related to instruction; the instruction was examined to see if it related to the objective; and the objective itself was reexamined and reaffirmed. Based upon this introspection, the standard was deemed realistic or unrealistic, instruction adequate or inadequate, or the objective appropriate or inappropriate. A summary of results from the use of the test items follows.

FIGURE 1



Unit 4, Subtest 1, "The Transfer of Energy through an Environmental System"

Table 1 contains a statistical summary of eight assessment items used as Subtest 1, "The Transfer of Energy through an Environmental System." The assessments were administered as part of Activities 4-1, 4-2, and 4-8 in Core A, Unit 4, "The Transfer and Cycling of Materials in My Environment," first and second experimental editions. This core dealt with energy and material transfer. Table 1 includes item assessment objectives, item weights, and other related statistics. The item assessment objectives are listed at the top of the table and explain the orientation of the subtest. Following this, the item weights are presented as a reflection of the value of each response to the total score for a particular item, and thus reflect the importance of a particular item to the total score for a subtest.

TABLE 1

Summary Information for Subtest 1,
"The Transfer of Energy through
an Environmental System"
(eight items)

This group of items assessed ability to

- complete food chains with missing links (Items 1 through 3)
- interpret a food chain diagram through a recognition of intermediate links (Items 4 through 6)
- interpret a food web diagram (Items 7 and 8)

Weights for each option

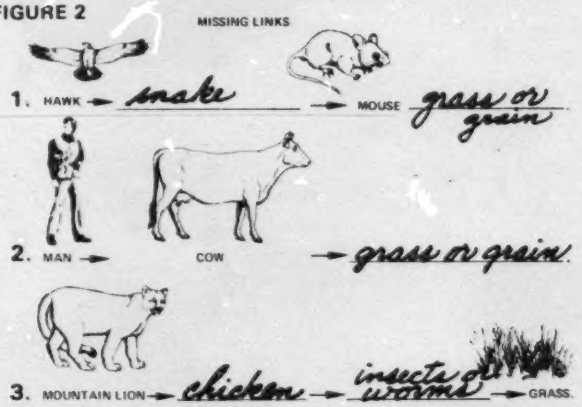
Item	Option					
	A	B	C	D	E	F
1	0	1	0	0	0	0
2	0	1	0	0	0	0
3	0	1	0	0	0	0
4	0	1	0	0	0	0
5	0	2	0	0	0	0
6	0	2	0	0	0	0
7	0	0	1			
8	0	2	0	0		

Maximum Possible Score: **11**
Range of Scores: **0-11**
Maximum Number of Students: **214**

This series of assessments evaluated as Subtest 1 represents a review of material taught the previous year in Unit 3, "Energy Relationships in My Environment." The Yes-No classification indicated in Figures 2, 3, and 4 reflects teacher estimate of acceptable performance.

Assessments 1 through 3 (see Figure 2) asked students to identify and write in the appropriate "missing link" from a series of labeled picture cards placed randomly on the chalk tray. The cards representing the correct responses to the blanks on the worksheet were snake, grass, grain, chicken, insects, or worms.

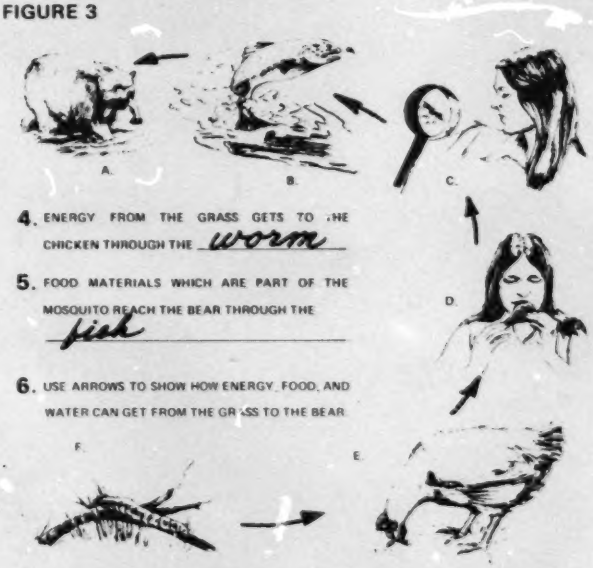
FIGURE 2



Item	Field Test I	Field Test II
1. Yes	80%	75%
No	20%	25%
2. Yes	89%	90%
No	11%	10%
3. Yes	60%	64%
No	40%	36%

Assessments 4 through 6 (see Figure 3) give an indication of the students' ability to interpret a representation of a food chain by either recognizing the position of intermediate links or by drawing arrows to indicate energy flow. These were judged to be items of greater cognitive difficulty because the inquiry skill "translation" is involved.

FIGURE 3


A.
B.
C.
4. ENERGY FROM THE GRASS GETS TO THE CHICKEN THROUGH THE worm
5. FOOD MATERIALS WHICH ARE PART OF THE MOSQUITO REACH THE BEAR THROUGH THE fish
D.
6. USE ARROWS TO SHOW HOW ENERGY, FOOD, AND WATER CAN GET FROM THE GRASS TO THE BEAR
F.
E.

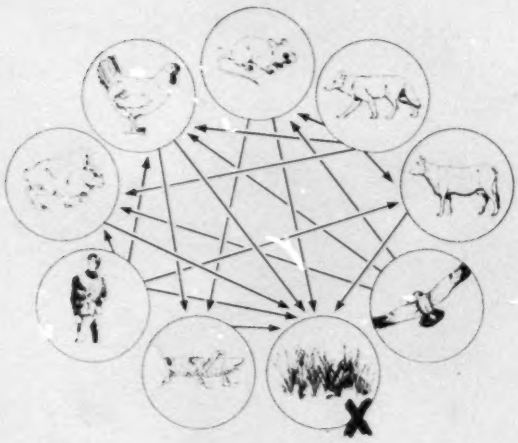
Item	Field Test I	Field Test II
4. Yes	80%	80%
No	20%	20%
5. Yes	57%	55%
No	43%	45%
6. Yes	58%	69%
No	42%	31%

Items of greatest complexity and interpretation are exemplified by Items 7 and 8 (see Figure 4). It was realized that students with visual perceptual skills undoubtedly would have problems with items presented in this manner. This was somewhat modified by the "hands-on" modeling and role-playing method of original instruction. This set of items was modified for commercial publication by limiting the complexity of the arrows, thus allowing for more direct interpretation.

FIGURE 4

7. WHAT LIVING THING GIVES FOOD ENERGY AND WATER TO EVERYTHING ELSE IN THE PICTURE?

MARK AN X ON YOUR CHOICE.



8. WHAT DOES THIS SET OF PICTURES SHOW?

A. MAN EATS MORE THAN OTHER ANIMALS.

X B. RABBITS ARE FOOD FOR HAWKS, COYOTES, AND MAN.

C. ALL THE ANIMALS EAT PLANTS.

D. RABBITS EAT COYOTES.

MARK AN X ON YOUR CHOICE.

Item	Field Test I	Field Test II
7. Yes	74%	57%
No	26%	43%
8. Yes	65%	48%
No	35%	52%

Thus, an analysis of the data reveals that a majority of the students performed at a level judged by the teacher to be acceptable in all but one case. The students performed above the staff standard (see Figure 1) on Field Test II on all items except number 7.

Unit 4, Subtest 2, "The Role of Microbes and Other Decomposers"

Table 2 contains a statistical summary of seven assessment items used as Subtest 2, "The Role of Microbes and Other Decomposers." The assessments were administered as part of Activities 4-16 and 4-20 in Core B, Unit 4, "Transfer and Cycling of Materials in My Environment," first and second experimental editions. Table 2 includes item assessment objectives, item weights, and other related statistics.

TABLE 2

Summary Information for Subtest 2, "The Role of Microbes and Other Decomposers" (seven items)

This group of items assessed ability to

- identify the optimal conditions for microbe growth (Items 9 through 11)
- identify a diagram of a cycle (Item 12)
- associate the characteristic of carbon dioxide production with that of microbe life and make a value judgment of a harmful versus beneficial relationship with people (Items 13 through 15)

Weights for each option

Item	Option			
	A	B	C	D
9	1	0	0	0
10	0	1	0	0
11	0	0	0	1
12	0	0	1	0
13	0	0	1	0
14	1	0		
15	0	1	0	0

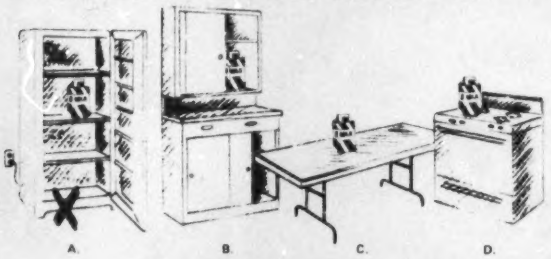
Maximum Possible Score: **7**
Range of Scores: **0-7**
Maximum Number of Students: **192**

Subtest 2 deals with the role of microbes and other decomposers. This portion of the materials builds upon what was introduced and developed rather fully in Unit 2, "Me As an Environment." The focus of Assessments 9 through 11 (see Figure 5) is now on food spoilage as brought about by various decomposers. Though student performance was above staff standards on all items except number 10, the items were somewhat modified for greater clarity. Labels designating the location or conditions pictured plus improved artwork should alleviate most of the confusion that did occur. Item 10 has been revised so that cartoons of bread slices more explicitly reveal the characteristics of temperature and humidity, and the suggested revision of the textual material has been made.

Assessment 12 (see Figure 6) again depicts the concept of a cycle in diagrammatic form. It involves the cognitive ability of the student to utilize the inquiry skill of translation. Though performance on this particular question far exceeded the staff standard and expectations, it was apparent from interviews with students the use of circles in the artwork depicting events was confusing. Some students felt all options represented cycles because all contained circles. This depiction has been changed in the commercial edition of Unit 4 to squares. In addition the introductory activity to the unit now involves the students in a definition of cycles through a series of demonstrations, "hands-on" laboratory activities, and study cards.

FIGURE 5

9. WHICH PLACE WOULD BE THE BEST TO KEEP MILK SO IT WILL NOT SPOIL?

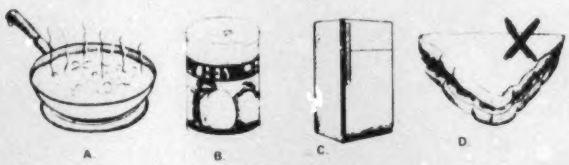


MARK AN X ON YOUR CHOICE.

10. WHICH BREAD WILL PROBABLY MOLD THE FASTEST?

MARK AN X ON YOUR CHOICE.

11. IN WHICH PLACE WOULD MICROBES GROW THE BEST?

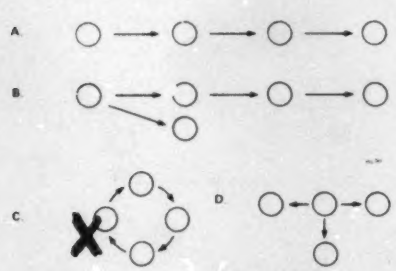


MARK AN X ON YOUR CHOICE.

Item and Option	Field Test I	Field Test II
9. A	100%	99%
Other	0%	1%
10. B	56%	54%
Other	44%	46%
11. D	86%	80%
Other	14%	20%

FIGURE 6

12. WHICH PICTURE SHOWS A CYCLE?



MARK AN X ON YOUR CHOICE.

Item and Option	Field Test I	Field Test II
12. C	79%	86%
Other	21%	14%

Assessments 13 through 15 (see Figure 7) test recognition of the association between microbe production of carbon dioxide and life and its relationship to people. They are based upon a recall of laboratory experiments performed by the students themselves. The fact that students performed below standard on Item 15 has been considered more a function of setting standards too high in relation to instruction rather than student performance. Thus the item was not revised for the commercial edition. However, greater stress was placed on the beneficial aspects of microbes through a revision of emphasis in various activities.

FIGURE 7

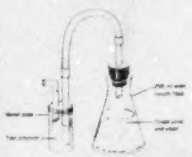
13. THE GRAPE JUICE-YEAST EXPERIMENT SHOWED THAT:

A. MICROBES ARE LARGE IN SIZE.

B. MICROBES ARE SMALL IN SIZE.

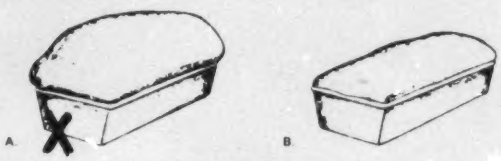
X C. MICROBES CAN GIVE OFF CARBON DIOXIDE.

D. MICROBES CANNOT GIVE OFF CARBON DIOXIDE.



MARK AN X ON YOUR CHOICE.

14. SALLY BAKED TWO LOAVES OF BREAD. ONE WAS MADE WITH YEAST AND ONE WAS MADE WITHOUT YEAST. WHICH LOAF HAD YEAST IN IT?



MARK AN X ON YOUR CHOICE.

15. FROM THE BAKED BREAD EXPERIMENT WE CAN SAY THAT:

A. MICROBES ARE BAD FOR US.

X B. SOME MICROBES HELP US.

C. YEAST IS NOT A MICROBE.

D. YEAST IS NOT USED IN BAKING.

MARK AN X ON YOUR CHOICE.

Item and Option	Field Test I	Field Test II
13. C	74%	69%
Other	26%	31%
14. A	96%	95%
Other	4%	5%
15. B	70%	69%
Other	30%	31%

Thus, an analysis of the data reveals that a majority of the students selected the correct response on all items. However, on Items 10 and 15 the percentage was below the standard set by the BSCS staff.

Unit 4, Subtest 3, "The Process of Recycling Materials in Finite Supply"

Table 3 contains a statistical summary of five assessment items used as Subtest 3, "The Process of Recycling Materials in Finite Supply." The assessments were administered as part of Activity 4-29 and Tallysheet 4-10 in Field Test I and Activity 4-27 and Worksheet 4-10 in Field Test II in Core C, Unit 4, "Transfer and Cycling of Materials in My Environment," first and second experimental editions. Table 3 includes item assessment objectives, item weights, and other related statistics.

TABLE 3

Summary Information for Subtest 3
"The Process of Recycling Materials in Finite Supply"
(five items)

This group of items assessed ability to

- relate the impact of garbage and the action of microbes on garbage to the environment (Items 16 and 17)
- select recycling as the appropriate method of dealing with certain materials (Items 18, 19, 20)

Weights for each option

Item	Option				
	A	B	C	D	E
16	0	0	3	3	5
17	0	3	0	0	0
18	0	3	0	0	0
19	0	1	0	0	0
20	0	1	0	0	0

Maximum Possible Score: **13**
Range of Scores: **0-13**
Maximum Number of Students: **193**

Subtest 3 deals with the actual process and mechanism of recycling materials in the environment. An analysis of the data reveals that student performance on this subtest was less than satisfactory, as measured by the staff standards. All items, materials, and procedures have been revised in response to teacher feedback.

FIGURE 8

16. HOW MANY OF THESE TELL WHY GARBAGE IS A PROBLEM?

- X A. THERE IS SO MUCH GARBAGE.
- X B. SOME GARBAGE WILL NOT DECOMPOSE.
- X C. SOME GARBAGE INVITES PESTS OR HELPS SPREAD DISEASE.
- X D. GARBAGE IS NOT PRETTY.
- X E. GARBAGE IS EXPENSIVE TO GET RID OF.

MARK AN X ON YOUR CHOICES.

NOTE:
Scoring on Item 16:

A = 1 of A, B, C, D, or E
B = 2 of A, B, C, D, or E
C = 3 of A, B, C, D, or E
D = 4 of A, B, C, D, or E
E = 5 of A, B, C, D, or E
F = N/A
G = No response
H = N/A

17. MARK AN X ON THE WORD THAT BEST TELLS ABOUT THE MICROBES THAT EAT GARBAGE.

A. LARGE	B. X HELPFUL	C. DEAD	D. USELESS

Item and Option	Field Test I	Field Test II
16. E	81%	62%
Other	19%	38%
17. B	51%	57%
Other	49%	43%

In the case of the impact of garbage and the action of microbes upon it, a further analysis of the curriculum materials upon which Assessments 16 and 17 (see Figure 8) were based indicated that the tie-in of this concept with that of transfer and cycling was weak. As a result the commercial revision simplified activities relating to garbage and more sharply focused the students' earlier work with composting and the effect of decomposers on various categories of trash.

FIGURE 9

18. WHICH PERSON IS DOING THE BEST THING FOR OUR ENVIRONMENT?

MARK AN X ON YOUR CHOICE.

19 and 20. LOOK AT THIS PICTURE STORY OF A DAILY NEWSPAPER.

MAKE AN ENDING BY EITHER WRITING ABOUT IT, DRAWING A PICTURE, OR TELLING ABOUT IT ON A TAPE RECORDER.

Item and Option		Field Test I	Field Test II
18.	B	58%	61%
	Other	42%	39%
19.	Yes	64%	34%
	No	36%	66%
20.	Complete	87%	83%
	Incomplete	13%	17%

Assessments 18 through 20 (see Figure 9) determine the extent to which students select the idea of recycling as the most appropriate method of disposing of various items. In Assessment 18 no one chose options C or D as correct. Option A was a strong distractor, with 40 percent of the students choosing it. This indicated that "disposal" versus "littering" was well inculcated, but that still greater emphasis on the recycling concept was needed. Since recycling is one of the behaviors the unit emphasizes, a sound filmstrip—*I'm the Very First Link*—and a recycling game—*Anyone Can*—were developed. When students did not meet the standard in Assessment 19, this decision was reaffirmed. Students here were to include some sort of recycling use in their ending to the story and were scored separately on their ability to complete it. As in the previous field test, students did well in completing the task, but far fewer indicated a recycling use. It is felt that the development of the game and filmstrip will add the emphasis and variety of presentation necessary in the commercial edition.

student performance on items assessing instruction in unit 5, "air and water in my environment," field test I

The experimental edition of Unit 5, "Air and Water in My Environment," was the single unit in the ME AND MY ENVIRONMENT curriculum that was field-tested only once. As indicated in earlier reports, the original grant to develop the program indicated that two years of materials would be developed for the junior high school. During field-testing, teachers and administrators made it clear that a third year of the curriculum should be developed to complete the three year junior high school schedule. As a result, Units 4 and 5 were written and field-tested by dovetailing the developmental formative evaluation process. Thus, though timelines were sufficient and funds were made available through a reallocation of priorities for the normal double cycle of field-testing and revision in the case of Unit 4, Unit 5 was limited to one field test. Thus, the population from which data were analyzed consisted of seven classes from the Field Test I group of teachers. Subsequently a contract was awarded to complete the evaluation and revision of the two units for commercial release.

During the field test, 112 items assessed curriculum materials and instruction in the thirty-five activities of Unit 5, "Air and Water in My Environment," experimental edition 1973-1974.

As with previous units, data for evaluation purposes were collected from "Clues to Success" activities that were incorporated in each unit. These activities were administered at various intervals immediately following instruction.

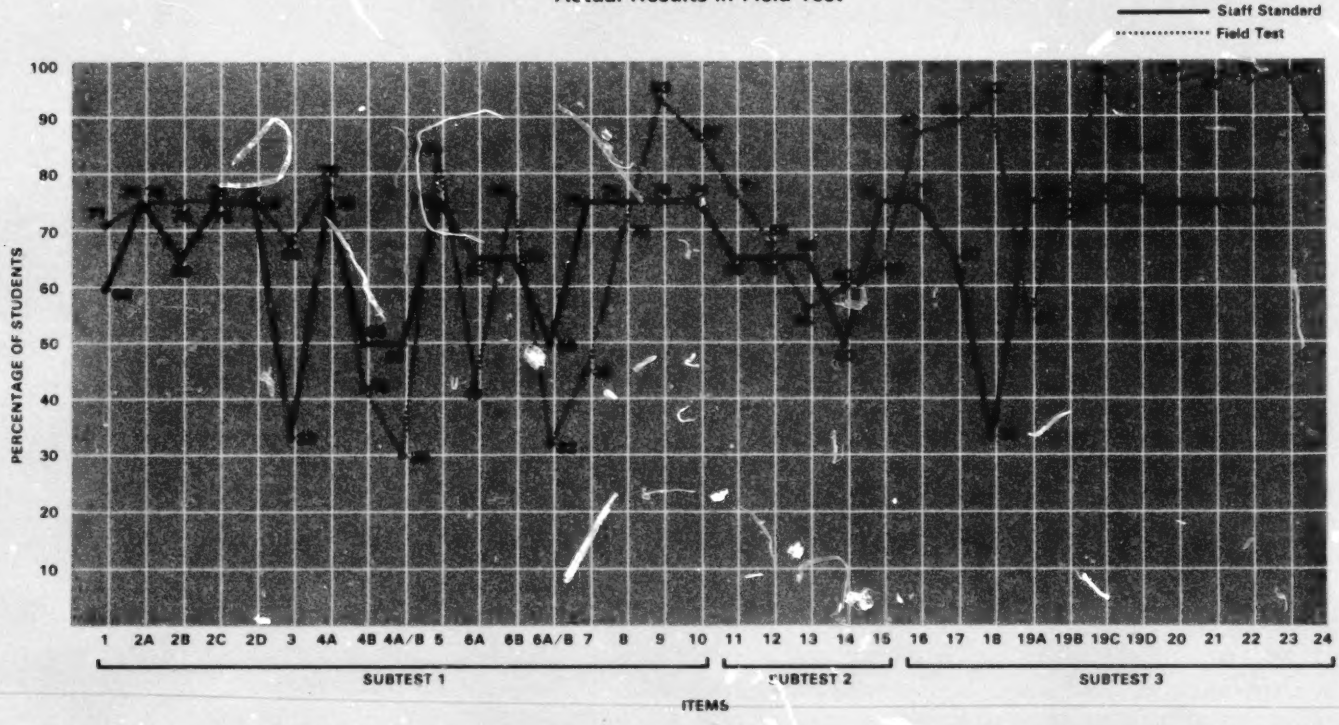
The population from which data were analyzed consisted of 110 EMH students from the seven classes. On some items, however, because of student absenteeism and attrition, as well as the disqualification of data, the population was considerably less than that indicated above. Data were disqualified for the same reasons as those given earlier in this report (page 4), to account for the disqualification of data from Field Test II of Unit 4.

Results on sample items are presented with a brief discussion of each item, the percentage of students responding successfully, and some additional data pertinent to item evaluation. A brief analysis is also provided as an explanation of revisions and expansions and/or deletions that took place in the commercial edition as a result of student performance on these assessments. It is important to note that only a few of the total of 112 assessment items are presented in this report. The reader interested in the remaining items is referred to the experimental edition of Unit 5, "Air and Water in My Environment." The items presented here were chosen because they are typical of student performance over a variety of activities.

In the case of the experimental version of Unit 5, the results of the twenty-four sample items for which complete data were collected again indicated certain strengths as well as weaknesses in the experimental materials field-tested. Here again they represented only one means used in evaluating this portion of the ME AND MY ENVIRONMENT materials, and as before, should not be used as a summative evaluation of student learning. However, it is of interest to note that students reached or exceeded staff standards in twenty of twenty-nine cases (see Figure 10). Some of the deviation from the standard must be considered to be a function of the relatively small sample size in comparison with that of other units, that the items themselves did not have the benefit of the revision and culling out that previous units had, and that the materials had not undergone the two complete cycles of field-testing and revision. However, the deviation does compare favorably with that observed during the first field test of the previous four units. Of even greater interest is the high performance of the students in the five items dealing with values, for which no standards were set. That a vast majority chose options generally considered to be the most environmentally sound would indicate a recognition of optimal behaviors on their part. It would be interesting to see if students actually perform these things in practice that they choose in theory.

FIGURE 10

A Comparison of Staff Standards of Achievement in Unit 5 with Actual Results in Field Test



Unit 5, Subtest 1, "Water in the Environment"

Table 4 contains a statistical summary of ten assessment items used within this subtest, "Water in the Environment." These assessment items were administered as Activity 5-21 on Worksheets 5-11A through 5-11D in Core D, Unit 5, "Air and Water in My Environment," experimental edition 1973-74. Table 4 includes item assessment objectives, item scoring, and some additional descriptive statistics.

Table 4

Summary Information for Subtest 1
"Water in the Environment"
(ten items)

This group of items assessed
- problem-solving ability (Items 1, 4,5, and 6)
- measurement skills related to the use of graphs (Items 2 and 3)
- understanding of the term "pollution" (Item 7)
- identification of means of conserving water (Items 8-10)

Weights for each option

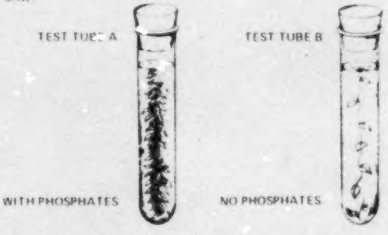
Item	Option						
	A	B	C	D	E	F	G
1	1	0	0	0	-	-	-
2	1	1	1	1	-	1	2
3	1	0	0	0	-	-	-
4	1	1	0	0	2	-	-
5	0	1	0	-	-	-	-
6	0	1	1	0	2	-	-
7	0	0	1	0	-	-	-
8	0	1	0	-	-	-	-
9	1	0	0	-	-	-	-
10	0	1	0	-	-	-	-

Maximum Possible Score: **13**
Range of Scores: **0-13**
Maximum Number of Students: **64**

Subtest 1 deals with aspects of water in the environment. Assessments 1, 4, 5, and 6 focus on problem-solving skills. Item 1 (see Figure 11) was designed to assess the ability to identify the question to be answered by an experiment. It was anticipated that students experiencing difficulty in problem-solving would have greater difficulty with the materials and need many concrete experiences for increasing this aspect of their development. Student performance on this item was satisfactory, with over 71 percent of the students selecting the appropriate options; responses of the other 29 percent were spread evenly over the remaining options.

FIGURE 11

1. JEFF SET UP AN EXPERIMENT. HE PUT GREEN PLANTS AND WATER IN TWO TEST TUBES. HE ADDED DETERGENT WITH PHOSPHATES TO TEST TUBE A. HE ADDED DETERGENT WITH NO PHOSPHATES TO TEST TUBE B. HE PUT BOTH OF THEM IN THE SUNLIGHT FOR ONE WEEK. THIS IS WHAT HE SAW.



WHAT WAS JEFF TRYING TO FIND OUT?

71% A. X IS PHOSPHATE DETERGENT A PLANT FOOD?
11% B. DO GREEN PLANTS LIKE SUNLIGHT?
8% C. DO GREEN PLANTS LIKE WATER?
10% D. DOES PHOSPHATE DETERGENT CLEAN GREEN PLANTS?

MARK AN X ON YOUR CHOICE.

Item 4 (see Figure 12) was designed to assess the problem-solving ability of predicting outcomes and refers to the two graphs discussed in Figure 14. Student performance was considered acceptable, with 90 percent of the responding students selecting A and/or B of the available options. The standards for Options B and the A/B combination were not met.

FIGURE 12

4. WHAT COULD A CITY LIKE GEORGETOWN DO TO KEEP FROM RUNNING OUT OF WATER?

X A. USE LESS WATER.
X B. STOP MORE PEOPLE FROM MOVING INTO THE CITY.
C. HAVE MORE WATER POLLUTION.
D. PUT PHOSPHATES IN THEIR DETERGENTS.

MARK AN X ON YOUR CHOICES.

A = A above	48%
B = B above	12%
C = C above	2%
D = D above	8%
E = A & B above	30%

Item 5 (see Figure 13) was designed to assess the problem-solving ability of knowing what varies in a problem. Student performance was considered excellent, with 84 percent of the students selecting the correct option.

Item 6 (see Figure 13) was designed to assess the problem-solving ability of predicting outcomes. On the basis of selecting one or the other correct option, student performance was considered excellent, with 87 percent of the students selecting B and/or C of the available options. However, the general ability of students to choose more than one option was again low. In questions of this kind, it must be emphasized that more than one correct option may appear.

Item 7 (see Figure 13) was designed to assess the student's understanding of the term "pollution." Student performance on this item was less than satisfactory, with option A as a distractor accounting for an excessive percentage of the score (40 percent). The response options were subsequently modified to reduce the confusion provided by option A.

Assessments 2 and 3 (see Figure 14) deal with graphing. Assessment 2 was designed to help determine the measurement skills of the student. Two dimensions of using a graph were measured. One (parts A and C) was the student's ability to locate a date on one axis and record the corresponding number. The other (parts B and D) was the student's ability to locate a given number on one axis and record the corresponding date. Student performance was satisfactory, with 75 percent of the responding students providing the correct response to all four of the items.

Assessment 3 was designed to determine the students' ability to interpret and draw conclusions from a graph. Student performance was considered satisfactory, with 68 percent of the responding students selecting the correct option, and the responses of the remaining students being spread over the other options. The performance was well over the standard set. Apparently the options were not as difficult as the staff anticipated.

Items 8-10 (see Figure 15) were designed to assess the students' ability to identify means of conserving water. Student performance on all three items was satisfactory, and significant material change was not indicated.

Student performance on this subtest was generally satisfactory, with the exception of a single item (Item 7), where results indicated a need for revision. All items drew written or subsequent oral interview responses from the students that demonstrated their understanding of the content.

FIGURE 13

5. LUIS SET UP AN EXPERIMENT TO FIND OUT WHAT HAPPENS TO FISH WHEN SEWAGE IS PUT IN THEIR WATER. HE PUT WATER AND FISH IN TWO JARS. HE ADDED SEWAGE TO JAR 2 ONLY. WHY DIDN'T HE PUT SEWAGE IN JAR 1?

8% A. HE DIDN'T HAVE ENOUGH SEWAGE.
84% B. X HE NEEDED SOMETHING TO COMPARE WITH JAR 2.
8% C. HE FORGOT TO PUT SEWAGE IN JAR 1.

MARK AN X ON YOUR CHOICE.

AFTER A LITTLE WHILE, THE FISH IN JAR 2 WAS SWIMMING NEAR THE TOP OF THE WATER. THE EXPERIMENT LOOKED LIKE THIS:

6. WHAT DID LUIS FIND OUT FROM THIS EXPERIMENT?

A. THE FISH IN JAR 2 LIKED THE SEWAGE.
X B. THE FISH IN JAR 2 CAME TO THE TOP.
X C. THE FISH IN JAR 2 DID NOT HAVE ENOUGH AIR.
D. THERE WAS LESS OXYGEN IN JAR 1 THAN JAR 2.

MARK AN X ON YOUR CHOICES.

A = A above	2%
B = B above	11%
C = C above	44%
D = D above	11%
E = B & C above	32%

7. WE LEARNED IN THIS ACTIVITY THAT WATER POLLUTION MEANS:

40% A. HOW TO KEEP WATER CLEAN.
3% B. FISH LIKE SEWAGE IN THEIR WATER.
45% C. X THINGS IN WATER THAT DON'T BELONG THERE.
12% D. USING SEWAGE FOR FERTILIZER TO MAKE PLANTS GROW.

MARK AN X ON YOUR CHOICE.

FIGURE 14

2. LOOK AT GRAPH 1. IT SHOWS THE NUMBER OF INCHES OF RAINFALL OVER A 20 YEAR PERIOD IN GEORGETOWN. NOW LOOK AT GRAPH 2. IT SHOWS THE NUMBER OF PEOPLE LIVING IN GEORGETOWN OVER A 20 YEAR PERIOD. USE THESE GRAPHS TO ANSWER THE QUESTIONS ON THE NEXT PAGE.

FOR STATEMENTS A, B, C, AND D, LOOK AT THE GRAPHS AND WRITE THE ANSWER ON THE LINE FOR EACH STATEMENT ABOUT GEORGETOWN.

GRAPH 1

75% A. IN 1950 THERE WERE 15 INCHES OF RAIN IN GEORGETOWN.
75% B. IN 1960 THERE WERE 17 INCHES OF RAIN IN GEORGETOWN.

GRAPH 2

75% C. IN 1960 THERE WERE 20,000 PEOPLE LIVING IN GEORGETOWN
75% D. IN 1970 THERE WERE 25,000 PEOPLE LIVING IN GEORGETOWN.

3. WHICH STATEMENT IS TRUE ABOUT GEORGETOWN FROM 1950 TO 1970? (LOOK AT BOTH GRAPHS.)

6% A. THERE WAS LESS RAIN AND FEWER PEOPLE OVER THE YEARS.
13% B. THERE WAS MORE RAIN AND MORE PEOPLE OVER THE YEARS.
13% C. THERE WAS MORE RAIN AND ABOUT THE SAME NUMBER OF PEOPLE FROM 1950 TO 1970.
68% D. X THE RAIN STAYED ABOUT THE SAME BUT THERE WERE MORE PEOPLE BY 1970.

MARK AN X ON YOUR CHOICE.

FIGURE 15

8. KATHY LIVED IN A TOWN MUCH LIKE YOUR OWN. THE AMOUNT OF WATER FOR THE TOWN TO USE WAS ENOUGH, BUT SINCE MANY MORE PEOPLE WERE MOVING INTO THE TOWN, KATHY WAS TRYING TO THINK OF WAYS SHE COULD SAVE WATER.

FOR EACH GROUP OF STATEMENTS BELOW, MARK AN X TO SHOW WHAT KATHY PROBABLY DECIDED ABOUT SAVING WATER.

15% A. WASH THE CAR EVERY WEEK.
70% B. X WASH THE CAR EVERY TWO WEEKS.
15% C. IT DOESN'T MAKE ANY DIFFERENCE IN THE AMOUNT OF WATER SAVED.

MARK AN X ON YOUR CHOICE.

9.

93% A. X SHUT OFF THE WATER WHEN BRUSHING HER TEETH.
1% B. LET THE WATER RUN WHEN BRUSHING HER TEETH.
6% C. IT DOESN'T MAKE ANY DIFFERENCE IN THE AMOUNT OF WATER SAVED.

MARK AN X ON YOUR CHOICE.

10.

5% A. PEEL VEGETABLES WITH THE WATER ON.
87% B. X PEEL VEGETABLES WITH THE WATER OFF.
8% C. IT DOESN'T MAKE ANY DIFFERENCE IN THE AMOUNT OF WATER SAVED.

Unit 5, Subtest 2, "The Exchange of Oxygen and Carbon Dioxide in the Environment."

Table 5 contains a statistical summary of five assessment items used within this subtest, "The Exchange of Oxygen and Carbon Dioxide in the Environment." These items were administered as a part of Activity 5-26 on Worksheets 5-13A and B, in Core E, Unit 5, "Air and Water in My Environment," experimental edition 1973-1974. Table 5 includes item objectives, item scoring, and some additional descriptive statistics.

Table 5

Summary Information for Subtest 2
"The Exchange of Oxygen and
Carbon Dioxide in the Environment."
(five items)

This group of items assessed
- students' knowledge of CO_2 production and use (Items 11-12)
- students' knowledge of O_2 production and use (Items 13-14)
- students' knowledge of the use of a control in an experimental design (Item 15)

Weights for each option

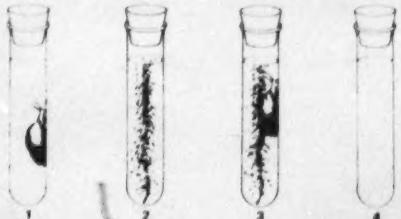
Item	Option			
	A	B	C	D
11	0	0	0	1
12	0	0	1	0
13	1	0	0	0
14	0	1	0	0
15	0	1	0	0

Maximum Possible Score: 5
Range of Scores: 0-13
Maximum Number of Students: 68

Items 11 and 12 (see Figure 16) were designed to assess the students' knowledge and recall of CO_2 production and use within a specific environment. Background for some of this information was presented in ME NOW as well as in Unit 4 of ME AND MY ENVIRONMENT. About 10 percent of the students demonstrated that there was some recall of those previous exposures. Student performance indicated a satisfactory level of understanding, with 77 percent selecting the correct option, Item 11, and 68 percent Item 12, with the remainder of the students' responses being spread over the other options.

Items 13 and 14 (see Figure 16) were designed to assess the students' knowledge and recall of O_2 production and use within the same series of laboratory activities. Upon first analysis it would appear that student performance was less satisfactory, with 56 percent selecting the correct option. However, the question itself was misleading since plants of course also give off carbon dioxide—a fact students had learned previously as a characteristic of life in Unit 4. The particular tests performed in the laboratory experiment did not show this, however. Thus no definite conclusion can be reached. Tentatively, it would appear that activities on the release of oxygen by plants have had less impact on the students than the activities on the release of carbon dioxide by animals. This may be accounted for in terms of prior instruction in the BSCS ME NOW program, which has

FIGURE 16



HERE IS A PICTURE OF THE EXPERIMENT THAT WE COMPLETED YESTERDAY IN SCIENCE CLASS. SEE HOW MUCH YOU REMEMBER ABOUT THE EXPERIMENT.

11. WE PUT A SNAIL IN THE WATER IN TEST TUBE 1. WHEN WE TESTED THE WATER THE NEXT DAY, WHAT DID WE FIND THAT THE SNAIL GAVE OFF?

2%	A.	MORE WATER
16%	B.	OXYGEN
5%	C.	YELLOW COLORING
77%	D. X	CARBON DIOXIDE

MARK AN X ON YOUR CHOICE.

12. IF WE LEFT THE SNAIL IN TEST TUBE 1 FOR A LONG TIME IT WOULD PROBABLY DIE, EVEN IF IT HAD FOOD. WHY?

18%	A.	IT WOULD USE UP ALL OF THE CARBON DIOXIDE.
4%	B.	IT WOULD DROWN.
68%	C. X	IT WOULD USE UP ALL OF THE OXYGEN.
10%	D.	IT WOULD GET TOO LONELY.

MARK AN X ON YOUR CHOICE.

13. IN THE WATER IN TEST TUBE 2 WE PUT A GREEN PLANT. WHAT DID WE FIND THAT THE PLANT GAVE OFF?

56%	A. X	OXYGEN
10%	B.	GREEN COLORING
29%	C.	CARBON DIOXIDE
5%	D.	YELLOW COLORING

MARK AN X ON YOUR CHOICE.

14. IF WE LEFT THE SNAIL IN TEST TUBE 3, IT WOULD PROBABLY LIVE A MUCH LONGER TIME THAN IT WOULD IN TEST TUBE 1. WHY?

3%	A.	IT WOULD NOT BE AS LONELY.
60%	B. X	THE PLANT WOULD GIVE OFF OXYGEN FOR IT TO BREATHE.
15%	C.	THE SNAIL WOULD NOT NEED OXYGEN WHEN LIVING WITH PLANTS.
22%	D.	THE PLANT WOULD GIVE OFF CARBON DIOXIDE FOR IT TO BREATHE.

MARK AN X ON YOUR CHOICE.

15. WHY DIDN'T WE PUT ANYTHING BUT WATER IN TEST TUBE 4?

6%	A.	WE DIDN'T HAVE ANYTHING LEFT TO USE.
63%	B. X	WE WANTED TO TEST WHAT WOULD HAPPEN TO THE WATER WITHOUT ANYTHING IN IT.
13%	C.	WE THOUGHT THE SNAIL OR PLANT WOULD DIE IN TEST TUBE 4.
18%	D.	WE DIDN'T WANT TO POLLUTE ANY MORE WATER.

MARK AN X ON YOUR CHOICE.

emphasized carbon dioxide release. Instruction has been intensive and realistic concerning the release of CO_2. The students use their own bodies as an example, as well as examples of a more abstract nature. Modification of Unit 5 will be accomplished to include extended instruction related to the release of O_2 by plants. Of surprise to the staff was that Option C in Item 11, and Option B in Item 13 did not turn out to be strong distractors, as anticipated. In reality, those were actual observations upon which the correct option could have been based.

Item 15 (see Figure 16) assessed the students' knowledge of the use of a control in an experimental design. Instruction on this subject had been presented many times, although not directly discussed in this activity. Student performance was judged unacceptable by the BSCS staff; sixty-three percent of the students selected the correct option, and the remaining responses were spread over the other options. It was decided, therefore to place greater emphasis on the use of controls in experiments; though as previously noted in Item 5 (Figure 13) students successfully chose the option relating to controls. The fact that only three options appeared in that question may have some bearing on the case.

Unit 5, Subtest 3, "Air in the Environment"

Table 6 contains a statistical summary of nine assessment items used within this subtest, "Air in the Environment." These items were administered as a part of Activity 5-34 on Worksheets 5-18 A-E in Core G, Unit 5, "Air and Water in My Environment," experimental edition 1973-74. Table 6 includes item objectives, item scoring, and some additional descriptive statistics.

Table 6

Summary Information for
Subtest 3, "Air in the Environment"
(nine items)

This group of items assessed

- The students' ability to read and use graphs (Items 16-17)
- The students' ability to understand that fumes may be harmful to living things (Items 18-19)
- The students' personal value judgments concerning air and water pollution (Items 20-24)

Weights for each option

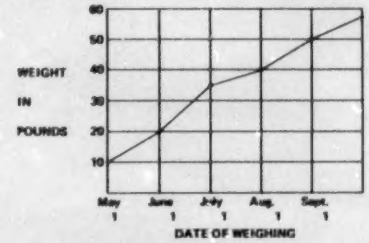
Item	Option			
	A	B	C	D
16	0	1	0	-
17	0	1	0	0
18	0	1	0	0
19	1	0	0	0
20	1	0	-	-
21	1	0	-	-
22	0	1	-	-
23	1	0	-	-
24	0	1	-	-

Maximum Possible Score: 9
Range of Scores: 0-9
Maximum Number of Students: 46

FIGURE 17

16. MICHAEL KEPT A GRAPH OF HIS DOG'S WEIGHT TO FIND OUT HOW MUCH FOOD TO GIVE HIS DOG. THE DIRECTIONS FOR FEEDING A DOG ARE:

WEIGHT OF THE DOG	CUPS OF DOG FOOD
20 TO 40 POUNDS	2 CUPS
41 TO 60 POUNDS	3 CUPS
OVER 60 POUNDS	4 CUPS



HOW MUCH DID THE DOG WEIGH ON JUNE 1?
WRITE YOUR ANSWER, 20 POUNDS

NOTE:
Scoring on Item 16: A = 10 pounds
B = 20 pounds
C = 30 pounds

Correct Answer: 87%

17. HOW MANY CUPS OF DOG FOOD EACH DAY SHOULD MICHAEL HAVE FED HIS DOG FOR THE MONTH OF AUGUST?

72% A. 2 X
17% B. 3
11% C. 4
D. NONE OF THESE ARE RIGHT.

MARK AN X ON YOUR CHOICE.

Items 16 and 17 (see Figure 17) were designed to assess the students' ability to read and use graphs. Information related to this area has been presented throughout the ME AND MY ENVIRONMENT materials. Student performance on Item 16 was acceptable, with 87 percent responding in an appropriate fashion. Performance on Item 17 indicated confusion, with 72 percent of the students selecting Option A (2 cups), which was not correct. Item revision considered improved instructions to eliminate the confusion of the single point on the graph and the continuous nature of the growth curve so the student understands that *during* the month of August the dog will weigh between forty-one and sixty pounds.

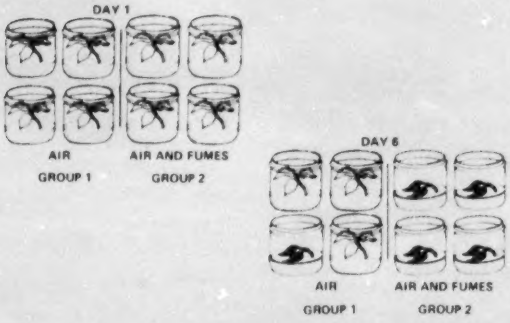
Item 18 (see Figure 18) was used to investigate the students' awareness that some fumes may be harmful to living things as well as to assess the higher level problem-solving skills of interpreting results and drawing conclusions. Ninety-three percent of the students selected the correct response, indicating an excellent level of performance.

The exceptional performance on this item should be interpreted in light of Item 1, Figure 11. In that item an experiment and a control were used to investigate a hypothetical situation. The similar cognitive processes involved may account for the high satisfactory achievement on this item. Additionally, the graphic presentation of the experiment (see Figure 18) could have enhanced performance.

Item 19 (see Figure 19) aided in the assessment of student understanding of the concept that fumes from various sources can be dangerous to man. Student performance was satisfactory on options B, C, and D. Performance on A, however, raised certain questions. The results may be interpreted as a problem peculiar to the sample, i.e., a large percentage of the students represented a single class, and instructor-specific procedures in that class might therefore account for the differences.

FIGURE 18

18. MARIE AND HER FATHER SET UP AN EXPERIMENT TO SEE WHAT HAPPENS TO LIVING THINGS IN AIR THAT HAS FUMES. THEY SET UP TWO GROUPS OF JARS. FOR GROUP 1, THEY PUT A GREEN PLANT IN EACH OF FOUR JARS CONTAINING AIR FROM THE KITCHEN. FOR GROUP 2, THEY PUT A GREEN PLANT IN EACH OF FOUR JARS CONTAINING FUMES FROM THE CAR. THEY COVERED ALL OF THE JARS IN BOTH GROUPS. THEY ADDED A LITTLE WATER TO ALL OF THE JARS EACH DAY FOR SIX DAYS. THEY ALSO ADDED CAR FUMES TO ALL OF THE JARS IN GROUP 2 EACH DAY. THE EXPERIMENT LOOKED LIKE THIS.



WHAT DID THEY FIND OUT FROM DOING THIS EXPERIMENT?

7%	A.	NOTHING, BECAUSE A PLANT DIED IN GROUP 1.
93%	B. X	FUMES FROM A CAR HARM LIVING THINGS.
	C.	AIR HARMS LIVING THINGS.
	D.	LIVING THINGS NEED WATER.

MARK AN X ON YOUR CHOICE.

Items 20-24 (see Figure 20) were used as indicators of the reported personal values regarding money, time, and effort involved in decisions on controlling air and water pollution. As was previously mentioned, the students reported in an appropriate fashion. Whether or not the values have been internalized to the point where they become factors in decision making is yet to be determined.

FIGURE 19

19. DO THESE THINGS USUALLY HAVE FUMES THAT ARE DANGEROUS TO MAN? WRITE YES OR NO ON EACH LINE.

		YES	NO
A.	THE INSIDE OF A SEWER	54%	46%
X B.	A BUSY HIGHWAY	75%	25%
C.	A GAS STOVE WITH A CRACK	96%	4%
X D.	A MOTORCYCLE	84%	16%

FIGURE 20

20. IT COSTS MORE MONEY TO BUILD A CAR THAT MAKES LESS AIR POLLUTION. IF YOU WERE BUYING A CAR, WOULD YOU

96% A. X PAY $500.00 EXTRA MONEY TO BUY ONE OF THE CARS THAT MAKES LESS AIR POLLUTION

OR

4% B. BUY A CAR THAT COSTS LESS BUT MAKES MORE AIR POLLUTION?

MARK AN X ON YOUR CHOICE.

21. IT TAKES MORE OF YOUR TIME TO GET RID OF DIRTY CAR OIL SO IT CAN BE USED AGAIN. IF YOU WERE BUSY AND DIDN'T HAVE MUCH TIME, WOULD YOU

98% A. X TAKE TIME TO BRING THE OIL SOMEWHERE SO IT COULD BE USED AGAIN

OR

2% B. DUMP IT DOWN A SEWER NEAR YOUR HOUSE?

MARK AN X ON YOUR CHOICE.

22. A FACTORY IN YOUR TOWN DOES NOT WANT TO SPEND MONEY TO CLEAN THE WATER IT USES. A GROUP OF PEOPLE IN TOWN WANT THE FACTORY TO CLEAN THE WATER IT USES. WOULD YOU

4% A. TELL THEM TO LET THE FACTORY DO WHAT IT WANTS TO DO AND MIND THEIR OWN BUSINESS

OR

96% B. X WRITE A LETTER TO THE MAYOR OF THE CITY TELLING HIM YOU WOULD LIKE TO SEE A LAW PASSED THAT FACTORIES MUST CLEAN THEIR WATER?

MARK AN X ON YOUR CHOICE.

23. EVERY OCTOBER YOU RAKE THE DEAD LEAVES AND BURN THEM IN THE STREET. THIS OCTOBER, WOULD YOU

98% A. X TAKE TIME TO PUT THE LEAVES IN BAGS FOR THE GARBAGE MEN TO TAKE

OR

2% B. BURN THE LEAVES AT THE CURB AS YOU ALWAYS DO?

MARK AN X ON YOUR CHOICE.

24. YOU DRIVE THE CAR TO WORK EVERY DAY. TO MAKE LESS AIR POLLUTION, SOME OF THE PEOPLE AT WORK ARE RIDING TOGETHER. RIDING TOGETHER WILL MEAN YOU MUST LEAVE THE HOUSE EARLIER IN THE MORNING AND GET HOME LATER AT NIGHT. WOULD YOU

16% A. KEEP ON DRIVING TO WORK ALONE SO YOU COULD SLEEP TEN MINUTES LATER

OR

84% B. X RIDE WITH THE OTHER PEOPLE TO HAVE LESS AIR POLLUTION IN THE CITY?

MARK AN X ON YOUR CHOICE.

I'm the Very First Link —
the evolution of a filmstrip **18**

A mini-field test of *Anyone Can* **20**

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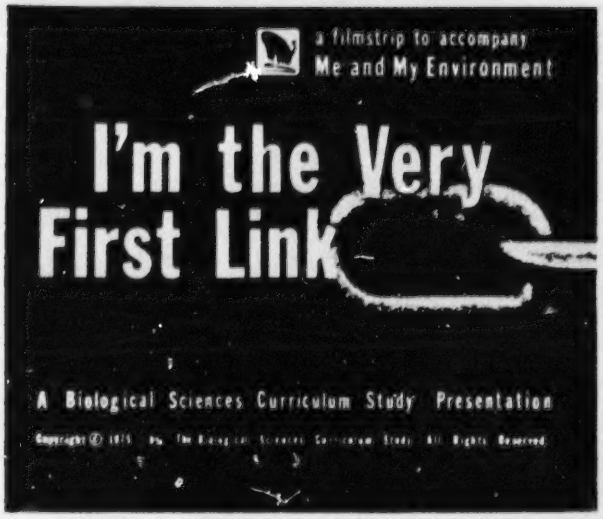
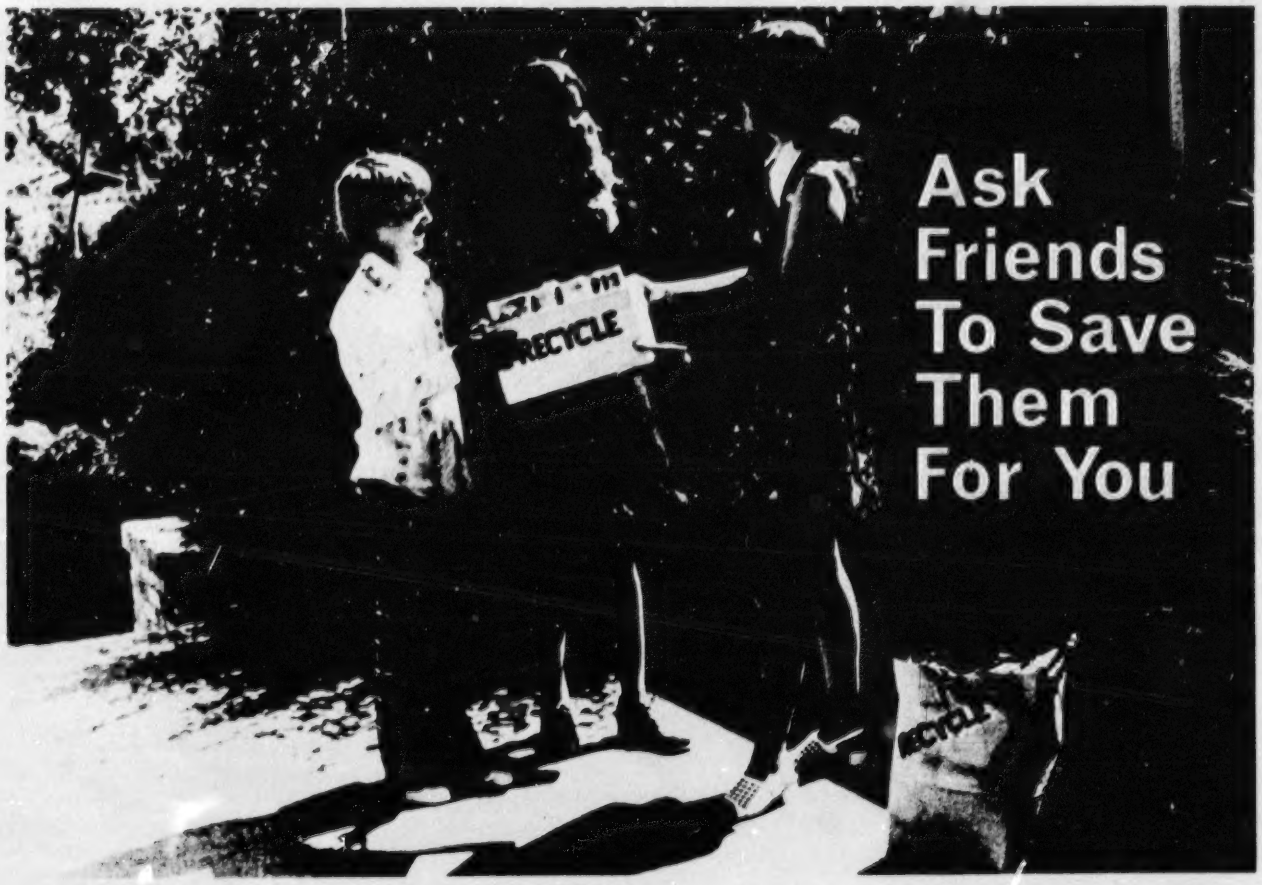
"i'm the very first link," the evolution of a filmstrip


a filmstrip to accompany
Me and My Environment
I'm the Very First Link
A Biological Sciences Curriculum Study Presentation

During the development of Unit 4 of ME AND MY ENVIRONMENT, the need became apparent for further materials on the link between garbage or trash and recycling. (See, for example, Figure 9, page 10.) Since a rather heavy emphasis had already been placed on recycling in the formal instruction, what was needed, the staff believed, was an individualized piece of media that the students could relate to their own experiences. To serve that purpose and to provide a motivational tool of high interest, a sound-filmstrip called *I'm the Very First Link* was developed.

The initial research for this project was undertaken by the BSCS revision staff. Numerous films, filmstrips, and promotional tapes were reviewed to see if any existing media satisfied both the content and delivery criteria for the target population. Additionally, organizations known to be concerned with recycling were contacted for information or materials that might be helpful.



The Adolph Coors Company had developed a fine filmstrip that happened to address itself to one of the goals of Unit 4: "Develop an understanding of cycling and appreciate the cycling relationship of the materials and organisms in the environment." The filmstrip also emphasized one of the goals of a subsection of the unit: "Infer the need to recycle materials." Moreover, the visuals, sound track, and organization of the film were appropriate for the target population of ME AND MY ENVIRONMENT. But even though there were no references to beer—the Adolph Coors Company product—the problems of releases, permissions, and rights could not be resolved. It was decided, therefore, to develop a sound filmstrip specifically tailored to the unit.

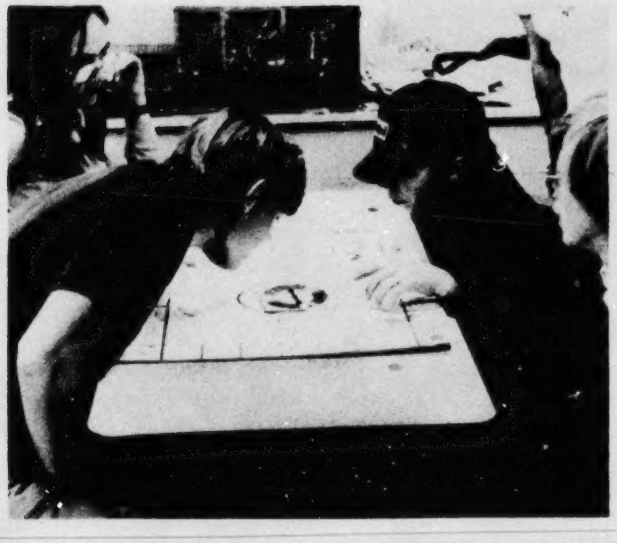
The next major step in the evolution of the filmstrip was the assignment of staff members to draft a script and storyboard for the reaction of those people who would be involved in production. These included a free-lance photographer, sound technician, artist, lyricist, as well as other members of the project staff. Two members of the staff, in fact, first suggested words and music for the two songs included in the sequence. Once the final script and storyboard were developed as a product of this interaction, young people of the target population age were contacted for voice, singing, and model auditions. Simultaneously, a local musician was engaged to work out the music and parts for the songs.

After a series of tests, a black girl and white boy were chosen as photographic models for the two main characters, a quartet of speaking voices was selected for those two characters and the two cartoon characters, and a quartet of singing voices was chosen. The music was revised and re-recorded, and a guitarist engaged to provide accompaniment. On-location photographs were taken and a full storyboard constructed.

Production of the filmstrip involved cooperation between the BSCS art staff and the technicians hired to form a sound production unit. While the filmstrip itself was being produced and animation added where necessary, actors and singers were busy with rehearsals for production of the audiotape. At the same time, the art staff worked on the production of title slides, spacing slides, and so on. Once these two production areas were in rough-draft form, editing of both was undertaken by other members of the staff, and suggested modifications were made where appropriate. Special care was taken to avoid perpetuating ethnic and sex-role stereotypes.

After several studio recording sessions, final editing of the revised materials resulted in a complete audiotape with audible signals for advancing the film, and the final series of visuals. The finished package was reviewed for continuity and conceptual flow, and approved for duplication. A teacher's guide providing instructions for use and integration into the instructional program was drafted and completed through the editing and rewrite process. With the guide in final form, the package was ready for distribution as part of the total program.

The evolution of this particular piece of media extended over several months and involved a considerable portion of the BSCS staff, as well as several individuals outside the organization who were able to provide specific expertise. The project was conceived to meet the needs of a special group of students, as those needs were interpreted by specialists in the field of education for the handicapped. *I'm the Very First Link* was the result.



a mini-field test of "anyone can"

During the spring of 1975, a new game called *Anyone Can* was conceived for Unit 4 of ME AND MY ENVIRONMENT. As a direct spinoff of the filmstrip *I'm the Very First Link* in Activity 4-24, it replaces the original *Recycling Payoff* game in Activity 4-25.

The original game, *Recycling Payoff*, was designed to teach the following objectives: the student will realize that because certain materials are in finite supply, the extent to which man uses these materials will have an impact on the environment; and, the student will recognize the need to recycle materials. The use of drilling rigs to prospect for water, oil, and gas, as well as for various metals, resulted in varying amounts of financial reward for the players. Those who took advantage of the opportunities for recycling (which resulted in lower immediate profits) versus those who did not (which resulted in higher immediate profits) were nonetheless the eventual winners. The basic design of the game provided for the exhaustion of the nonrenewable metal in the rigs, preventing future drilling unless recycling was provided. Though students thoroughly enjoyed the game, the indications were that a large percentage had difficulty relating it to the objectives. In addition, it was too far removed from the students' own experiences and reality. Thus, as a result of the experience during the formative evaluation, a more direct and straightforward approach was conceived.

The new game board for *Anyone Can* is meant to represent a hypothetical hometown; empty cans litter the parks, schoolgrounds, parking lots, and ditches, and they are also found in everyone's trash. The object of the game is to pick up the cans, get them to the Recycling Center, and exchange them for cash. Students gain not only an understanding of recycling and the need to conserve natural resources, but also a concrete experience in the process of recycling cans. The direct transfer of learning from a specific classroom activity to a real-life situation is thus facilitated.

Purpose:

The purpose of the field test was twofold:

1. To determine the appropriateness of the game for the target population; and
2. To incorporate any ideas of EMH students for design or needed modifications.

Classes Involved:

The field-testing was conducted in two Colorado schools—Centaurus High School in Lafayette and Casey Junior High School in Boulder—with classes of EMH students. (Subsequently, it was used with regular students, who also enjoyed it.)

Length of Time:

The length of time the game took varied from thirty minutes to one hour and fifteen minutes; the game can be stopped at any time, however, depending on the length of class periods and the enthusiasm of the students.

Examples of Comments Made by the Students:

1. "Neat game."
2. "It's fun."
3. "A lot better than Monopoly."
4. "Most fun is winning."
5. "Most fun is playing."
6. "Not too shabby." (When translated means, "It's a good game; I like it.")
7. "This is a fun game."
8. "I liked it."

Evaluation Questions Asked the Students by the Observers:

1. Is the game too difficult?
2. Is the game too easy?
3. Is it fun to be bumped off the game board?
4. What changes would you like to see made?

Some Problems Encountered with the Target Population:

1. With a flat surface, the cans got a little scattered as moves were made around the board. They were brushed by the students' arms.
2. The playing pieces and cans were too lightweight on the prototype. As the students talked, they accidentally blew some of the pieces off the game board.
3. The pieces and cans were difficult to pick up, especially for students with motor coordination difficulties.
4. Question was asked, "What is the purpose of the trash container?"
5. Use of two playing pieces was found to be the maximum. Two of the students had trouble keeping track of even two of the pieces.
6. One of the spaces on the game board read, "KEEP THE ENVIRONMENT BEAUTIFUL, PICK UP A CAN IN THE PARK." The students remarked, "It doesn't tell you how many to pick up." Therefore, the observer changed "a can" to read "1 can."
7. Even with the large arrows indicating the path to the Recycling Center, after one trip around the board the students had to be reminded by the observer to move their playing pieces onto the path.
8. Some students had problems figuring out *half* of the cans in the park as well as multiplying their cans by two when they entered the Recycling Center (they collected two cents per can). A teacher must be available for assistance as the game is played the first few times. Perhaps a chart of multiplication tables by two's could be available to the students for figuring.
9. One of the cards in the pack read "A-w-w-w." This was confusing and was changed to read, "Too Bad."
10. The play coins were difficult to differentiate -pennies, nickels, and dimes. All were the same color.
11. A few vocabulary words such as "dump," "ditch," and "environment" were stumbling blocks at first. With the help of an observer and other students at the beginning of the game, however, the vocabulary was picked up. The students were reading their own cards toward the end of the game.

Suggestions Made by Students:

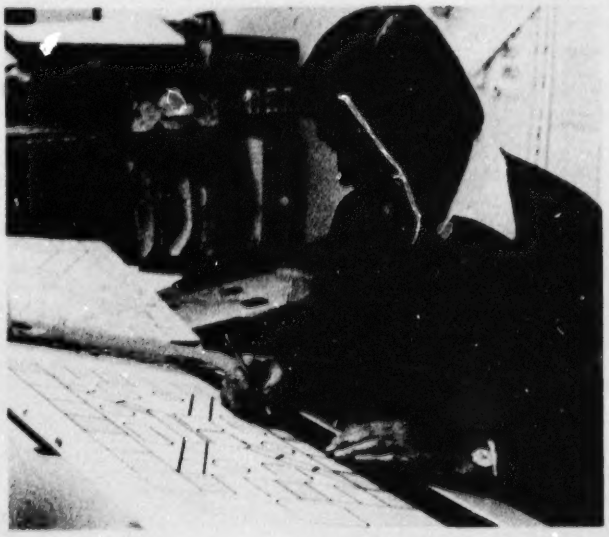
1. Buy real cans to use.
2. Use cars for playing pieces.
3. Use people for playing pieces.

Summation:

The overall response to the mini-field test was successful. The students were excited and expressed enjoyment with the game. Even though one group of students extended the game to one hour and fifteen minutes, their attention span lasted throughout the game and they were excited until the very end, when a player unexpectedly ended the game by getting both playing pieces into the Recycling Center.

The classroom teachers expressed enthusiasm and shared positive comments with the observers.

As a result of this activity, the game was modified to include appropriate changes indicated by the information provided in the field test.



the bscs process—a systems approach

Introduction

A systems design approach to analyzing the development of a curriculum package for educable mentally handicapped youngsters is presented here in an attempt to identify the components, subcomponents, and interrelationships involved. Such an approach enables curriculum designers to formulate aggregates of components from the whole into subunits for analysis. The formation of subunits follows a logical sequential order that begins with the initial curriculum planning stage and ends with the final commercial product stage. The specification of subunits allows curriculum designers to isolate the various stages of curriculum development. Thus, the designer is able to identify resources, personnel, processes, and activities associated with specific stages of curriculum development; moreover, the specification of subunits enables a curriculum designer to evaluate the ongoing processes of curriculum development formatively.

In describing and analyzing curriculum development at the BSCS, a transformation-operation (Black Box) systems model incorporating a storage unit will be used. The system will be presented in a flow chart format. The symbols used in this systems model are illustrated in Diagram 1, a general systems model. The input symbol represents a procedure for making information available for processing from personnel, records, and other sources. The processing symbol represents a set of procedures or activities to be carried out at a particular stage. The output symbol represents the completion of a set of procedures or activities. The store symbol represents the storage of output information to be used at a later stage of curriculum development.

DIAGRAM 1 General Systems Model

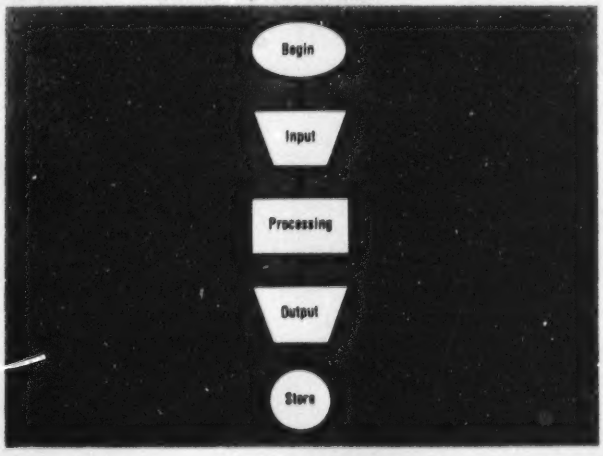
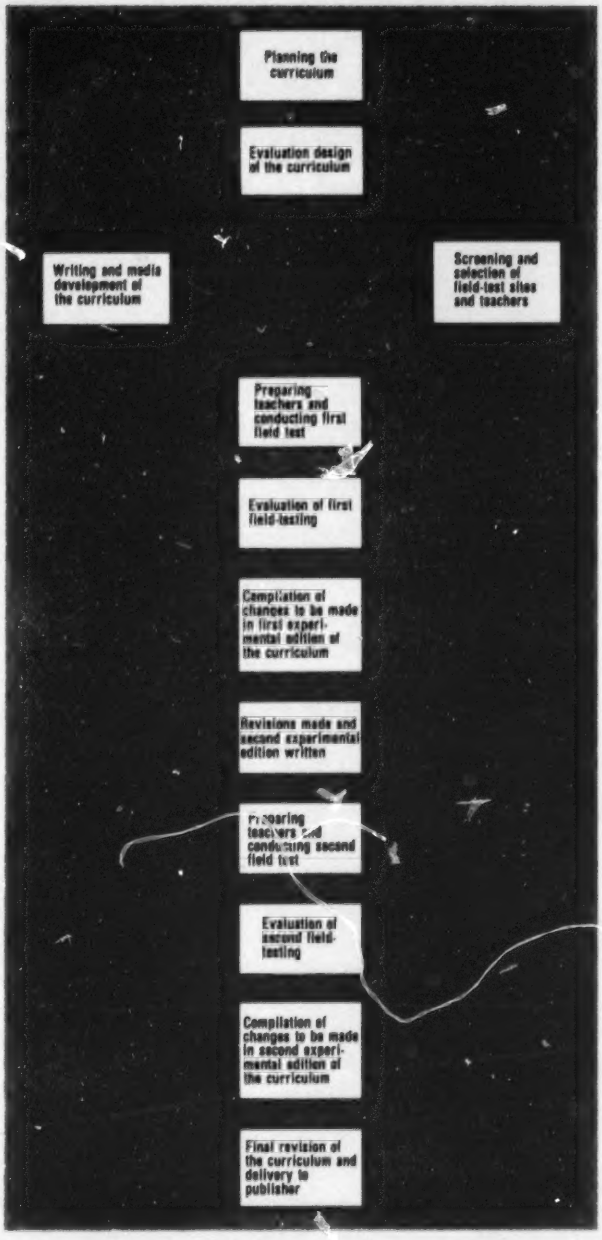


DIAGRAM 2 Stages of Curriculum Development from Initial Planning Stage to Final Product


Planning the curriculum
Evaluation design of the curriculum
Writing and media development of the curriculum
Screening and selection of field-test sites and teachers
Preparing teachers and conducting first field test
Evaluation of first field-testing
Compilation of changes to be made in first experimental edition of the curriculum
Revisions made and second experimental edition written
Preparing teachers and conducting second field test
Evaluation of second field-testing
Compilation of changes to be made in second experimental edition of the curriculum
Final revision of the curriculum and delivery to publisher

The transformation-operation systems model used to describe and analyze curriculum development at BSCS is comprised of twelve stages, or subsystems. A schema depicting the twelve stages of curriculum development is presented in Diagram 2. The schema represents a descending hierarchy of sequential curriculum developmental stages related to producing curriculum materials. Stages of curriculum development range from the initial planning, Stage 1, to the final commercial product, Stage 12.

A brief description of each stage represented in Diagram 2 will provide the reader with an overview of the various stages involved in developing and producing a curriculum. Stage 1

consists of planning the curriculum framework by determining its philosophical and theoretical orientation. After the planning stage, the evaluation design and associated data-collecting devices for evaluating the effectiveness of the curriculum are formulated at Stage 2. Upon completion of Stage 2, writing and media development of the first experimental curriculum takes place at Stage 3; the screening and selection of field-test sites and teachers to field-test the first experimental edition of the curriculum occur simultaneously at Stage 4. Upon completing the activities of Stages 3 and 4, developers select the teachers for the first field-testing and these teachers attend a session at the BSCS for orientation in the use of the instructional materials. This orientation constitutes Stage 5. After completing the training program, teachers begin field-testing the first experimental edition of the curriculum. The results of the field tests are evaluated at Stage 6. Based upon Field Test I and other input data, a compilation of changes to be made in the first experimental edition of the curriculum is formulated at Stage 7.

Next, revisions in the first experimental edition of the curriculum are incorporated into the second experimental edition. These activities occur at Stage 8. When the second experimental edition of the curriculum is ready for dissemination, a second group of field-test teachers attend a BSCS program on orientation and implementation of the revised experimental curriculum. This orientation session takes place at Stage 9. Upon completion of the training program, the second group of field-test teachers begins instruction and field-testing. Upon completion of the second field-testing, the data are analyzed and evaluated at Stage 10. When this evaluation is completed, compilation of changes and recommended revisions to be made in the second experimental edition of the curriculum are formulated at Stage 11. Revisions are made and incorporated into the final draft of the curriculum at Stage 12. When this stage is reached, the curriculum materials are released for commercial publication.

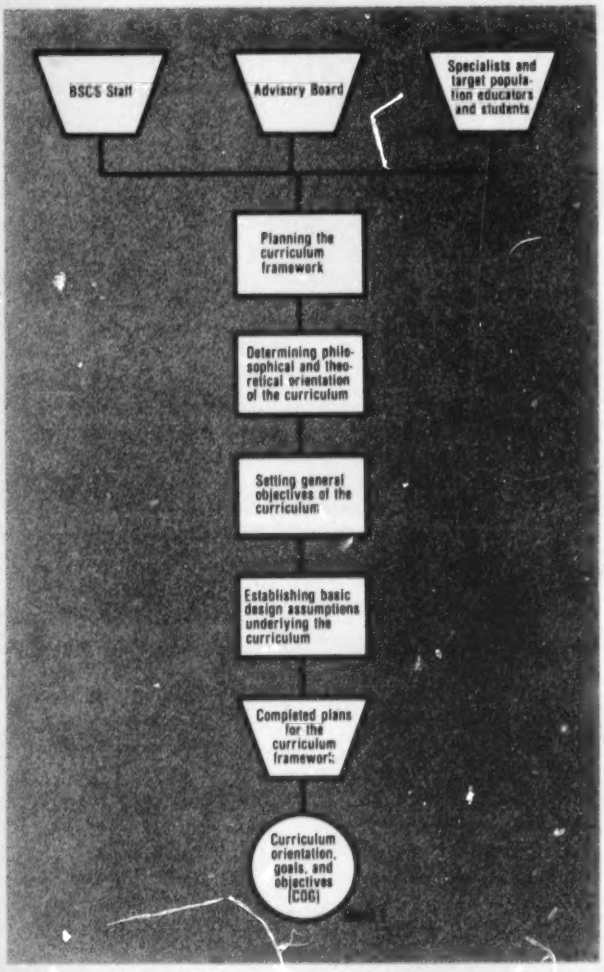
The above review is intended to depict the sequential steps that are involved in the process of developing and producing a curriculum.

At this point, the twelve stages of curriculum development will be considered as components constituting a complete system, and each stage of development will represent a subsystem within the total curriculum developmental system. Each subsystem will be discussed and analyzed in the following terms: input data, processing of information, output of the processed information, and storage of information to be entered as input data in a later stage.

Stage 1

The analysis of the various stages of curriculum development by using a subsystem approach begins by describing Stage 1—planning the curriculum framework. This stage is represented in Diagram 3. Planning the curriculum framework initially involves input from the BSCS staff, the Advisory Board, and specialists and target population educators and students. These three groups are engaged in the process of: (1) determining the philosophical and theoretical orientation of the curriculum, (2) setting the general objectives of the curriculum, and (3) establishing the basic design assumptions underlying the curriculum. The output of this stage is the formulation of a curriculum framework. The formulated curriculum orientation, goals, and objectives are available in Store 1 for use as input information in later stages.

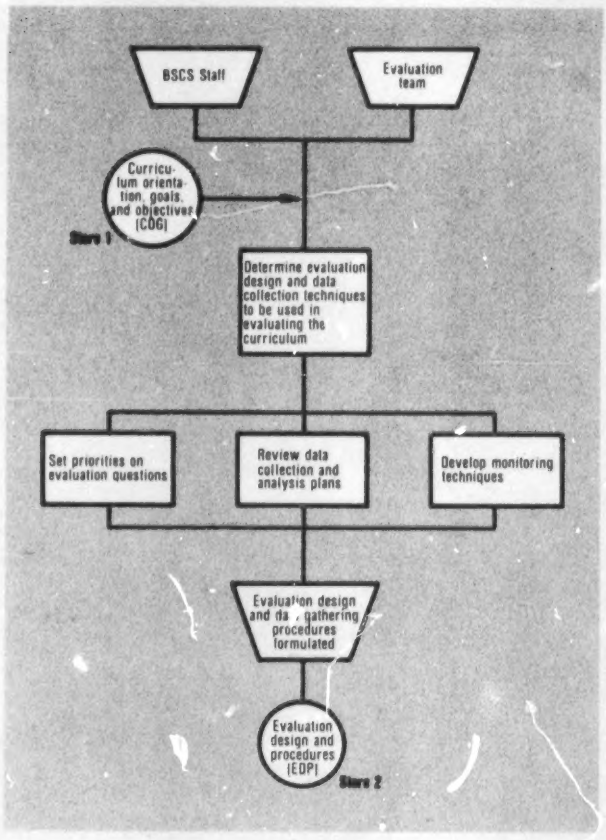
DIAGRAM 3 Stage 1. Planning the Curriculum Framework


BSCS Staff
Advisory Board
Specialists and target population educators and students
Planning the curriculum framework
Determining philosophical and theoretical orientation of the curriculum
Setting general objectives of the curriculum
Establishing basic design assumptions underlying the curriculum
Completed plans for the curriculum framework
Curriculum orientation, goals, and objectives (COG)

Stage 2

At Stage 2, the evaluation design of the curriculum is formulated. This stage is represented in Diagram 4. The input sources in this stage are evaluation team members and the BSCS staff. The evaluation team members consist of curriculum evaluation experts in special and science education. Also, information stored at Store 1 is entered into the evaluation stage as input data or background information. Evaluation team members and the BSCS staff engage in the process of determining the overall evaluation design of the curriculum. This major process consists of the following subprocesses: (1) set priorities on evaluation questions, (2) review and establish data-collection and analysis plans, and (3) develop curriculum monitoring techniques. The output of the above activities is the formulation of the curriculum evaluation design, with associated implementation strategies, and this information is stored (Store 2) for further use in the curriculum development system.

DIAGRAM 4 Stage 2, Evaluative Design of the Curriculum

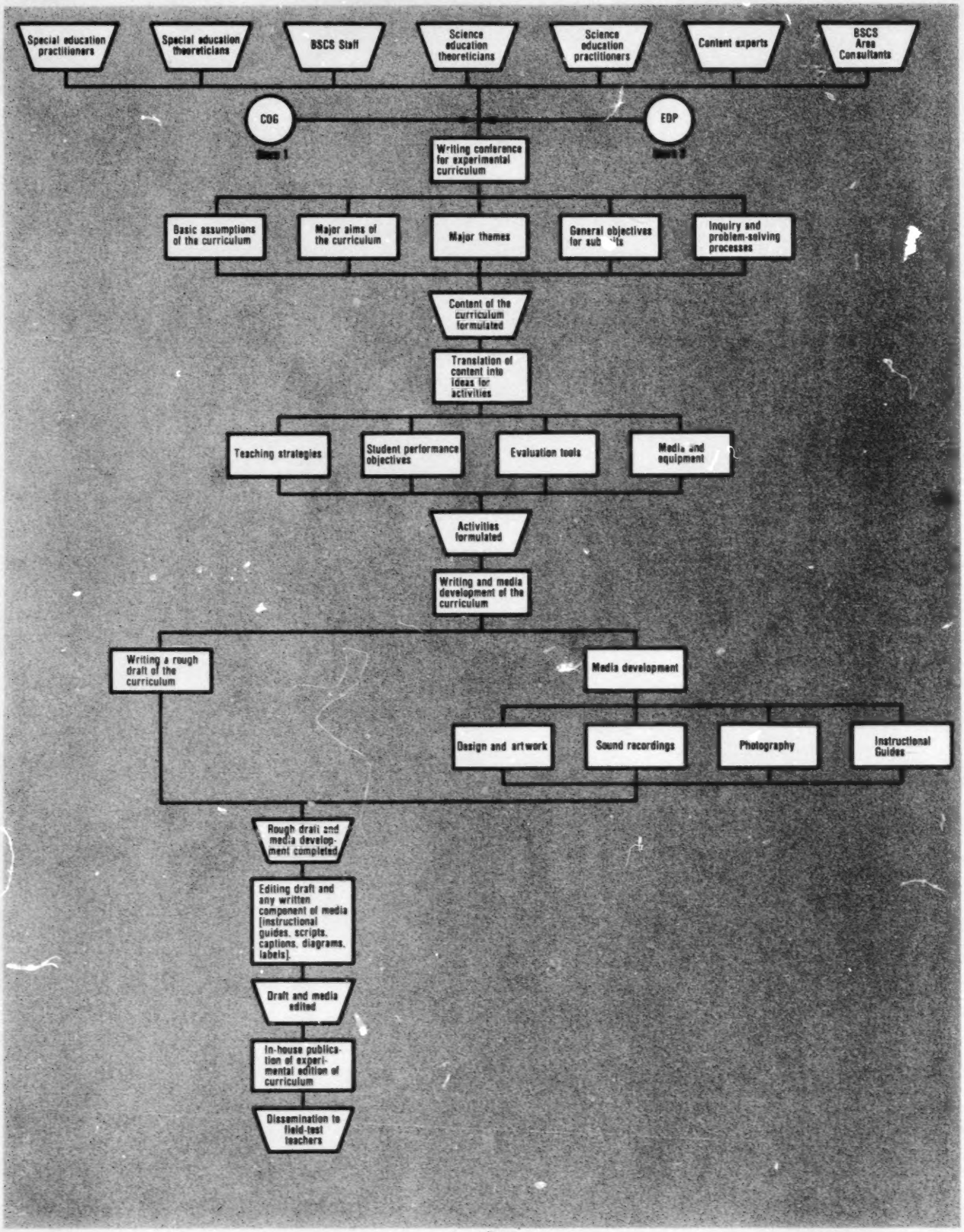

BSCS Staff
Evaluation team
Curriculum orientation, goals, and objectives (COG)
Store 1
Determine evaluation design and data collection techniques to be used in evaluating the curriculum
Set priorities on evaluation questions
Review data collection and analysis plans
Develop monitoring techniques
Evaluation design and data gathering procedures formulated
Evaluation design and procedures (EDP)
Store 2

Stage 3

The writing and development of media for the first experimental curriculum are represented in Diagram 5. The input sources for this stage are: (1) special education practitioners, (2) special education theoreticians, (3) BSCS Staff, (4) science education theoreticians, (5) science education practitioners, (6) biological science content experts, and (7) BSCS Area Consultants. Also, stored information obtained from curriculum orientation, goals, and objectives (COG) and evaluation design and procedures (EDP) are entered into the subsystem as input information providing a framework for the writing conference. Various input members are engaged in the processes of (1) formulating the content of the curriculum, (2) translating the content into activities, and (3) writing and developing media for the curriculum.

The formulation of content involves the following subprocesses: (1) establishing the basic assumptions of the curriculum, (2) stating the major aims of the curriculum, (3) establishing the major themes of the curriculum, (4) establishing the general objectives of the subunits or cores of the curriculum, and (5) designing inquiry and problem-solving processes. The process of translating the content into curriculum activities involves several subprocesses. They are: (1) designing teaching strategies, (2) formulating student performance objectives and associated evaluation tools such as student records of progress, and (3) developing media and specifying equipment needed to implement the activities of the curriculum.

DIAGRAM 5 Stage 3, Formulating and Writing the Experimental Curriculum

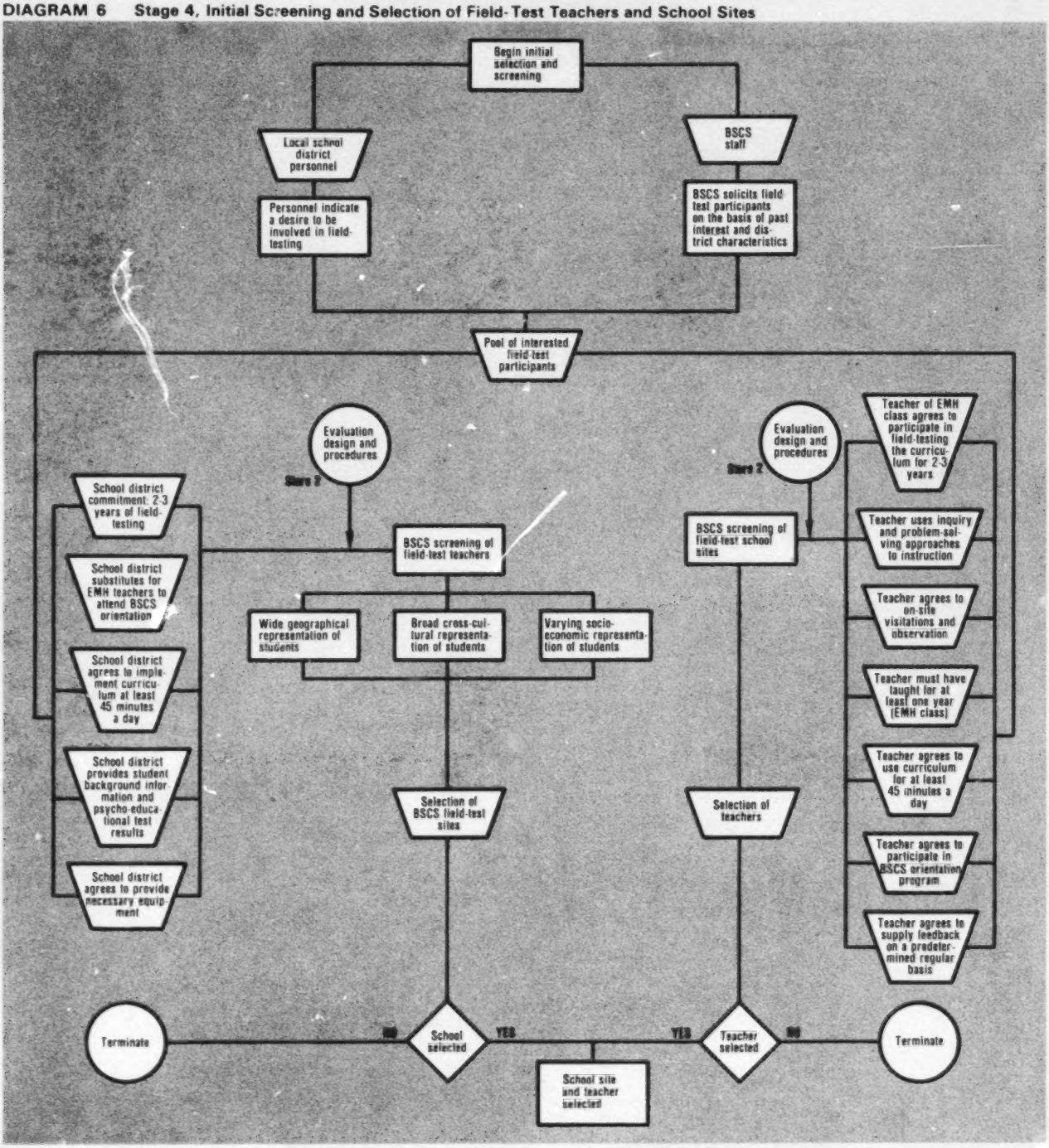


After the activities of the curriculum are formulated, selected members from the input sources, including BSCS staff, engage in the process of writing the rough draft and developing media for the first experimental curriculum edition. The process of media development involves the use of BSCS specialists in the areas of art, sound recording, and photography. The complete written rough draft and associated media developed enters the editing process. When the editing of the rough draft is completed, the draft is revised and submitted for in-house publication. When the first experimental curriculum edition is published, it is ready for dissemination to field-test teachers and others involved in the field test.

Stage 4, Initial Screening and Selection of Field-Test School Sites and Teachers

Diagram 6 represents Stage 4, the initial screening and selection of field-test teachers and school sites for

DIAGRAM 6 Stage 4, Initial Screening and Selection of Field-Test Teachers and School Sites


Begin initial selection and screening
Local school district personnel
Personnel indicate a desire to be involved in field-testing
BSCS staff
BSCS solicits field-test participants on the basis of past interest and district characteristics
Pool of interested field-test participants
Evaluation design and procedures
Store 2
School district commitment: 2-3 years of field-testing
School district substitutes for EMH teachers to attend BSCS orientation
School district agrees to implement curriculum at least 45 minutes a day
School district provides student background information and psycho-educational test results
School district agrees to provide necessary equipment
BSCS screening of field-test teachers
Wide geographical representation of students
Broad cross-cultural representation of students
Varying socio-economic representation of students
Selection of BSCS field-test sites
Terminate
NO
School selected
YES
Evaluation design and procedures
Store 2
BSCS screening of field-test school sites
Selection of teachers
YES
Teacher selected
NO
Terminate
Teacher of EMH class agrees to participate in field-testing the curriculum for 2-3 years
Teacher uses inquiry and problem-solving approaches to instruction
Teacher agrees to on-site visitations and observation
Teacher must have taught for at least one year [EMH class]
Teacher agrees to use curriculum for at least 45 minutes a day
Teacher agrees to participate in BSCS orientation program
Teacher agrees to supply feedback on a predetermined regular basis
School site and teacher selected

participation in the field-testing of the experimental curriculum. The initial screening for field-test school sites and teachers begins with input from local school district personnel and BSCS staff. The process of initial screening begins when school personnel indicate a desire to be involved in field-testing, and BSCS staff members solicit field-test participants, basing their judgments on the past performance of the potential participants, as well as on the interest and characteristics of the individual districts. When that information is processed, a pool of interested field-test participants and school sites is obtained; then both groups of input data are simultaneously processed in relation to school district and teacher criteria.

The process of screening prospective field-test school sites and teachers involves a variety of school district and teacher input data. School district input data involve the following information: (1) a school district commitment to participate in field-testing for two or three years; (2) the school district agrees to provide substitutes for field-test teachers so they may participate in BSCS training sessions on the use of the experimental curriculum; (3) the school district agrees to implement the experimental curriculum for at least forty-five minutes a day; (4) the school district agrees to provide student background information, including psycho-educational test results; and (5) the school district agrees to provide the necessary audiovisual equipment to implement the curriculum. Stored information from Stage 2 (evaluation design and procedures) is entered into this subsystem to be used as a standard in the screening of field-test school sites.

Upon completing the initial screening of school sites, the process of selecting prospective school field-test sites involves the following criteria: (1) wide geographical distribution of students; (2) cross-cultural distribution of students; and (3) varying socio-economic levels of students. If a school district meets all three of the above criteria, it is considered for selection as a field-test site. If a school district does not meet all of those standards, it is usually passed over for field-testing.

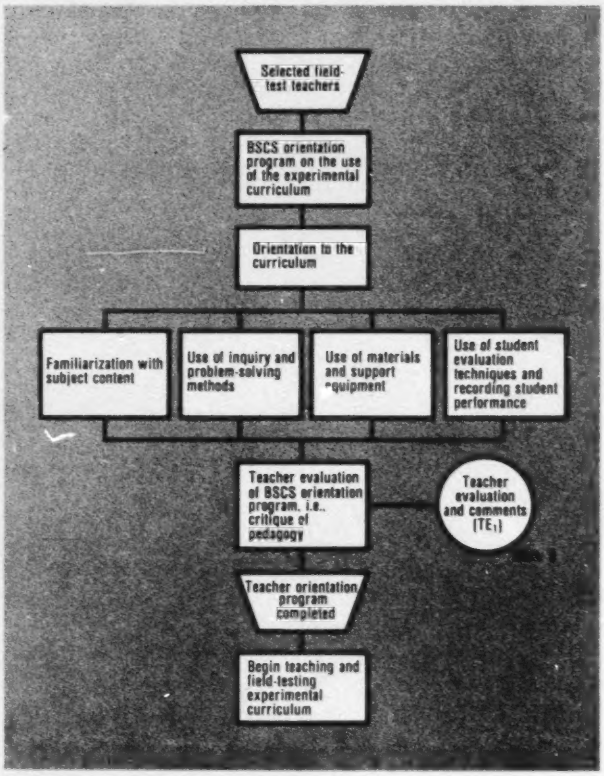
Input data used in teacher screening for field-testing are: (1) participate in field-testing the experimental curriculum for two to three years; (2) at least one year of experience in teaching EMH students; (3) supply feedback to BSCS on a predetermined regular basis; (4) agree to on-site visitations; (5) participate in a BSCS training program; (6) use inquiry and problem-solving approaches to instruction; (7) use the curriculum for at least forty-five minutes a day. Information stored from Stage 2 (evaluation design and procedures) is entered as input data in order to provide a criteria for selecting prospective field-test teachers.

After the initial screening and selection procedures are conducted for both prospective school sites and teachers, the school site and teacher must be matched in order to make final selection of field-test sites. (It should be noted that enough field-test sites were selected to conduct two field tests of the experimental curriculum of ME AND MY ENVIRONMENT.)

Stage 5, Preparing Teachers and Conducting First Field Test

The stage involving the process of introducing field-test teachers to the curriculum is represented in Diagram 7. Selected teachers engage in the process of learning how to implement the first edition of the experimental curriculum. The process of orienting teachers to the curriculum involves

DIAGRAM 7 Preparing Teachers and Conducting First Field-Test


Selected field-test teachers
BSCS orientation program on the use of the experimental curriculum
Orientation to the curriculum
Familiarization with subject content
Use of inquiry and problem-solving methods
Use of materials and support equipment
Use of student evaluation techniques and recording student performance
Teacher evaluation of BSCS orientation program, i.e., critique of pedagogy
Teacher evaluation and comments (TE_1)
Teacher orientation program completed
Begin teaching and field-testing experimental curriculum

the following elements: (1) familiarization with subject content; (2) use of inquiry and problem-solving methods; (3) use of media and support equipment; and (4) use of student evaluation techniques. Upon completion of the BSCS orientation program, teachers engage in the process of evaluating the BSCS training procedures, pedagogy, and the like. The teacher evaluation information is stored (Store 3) for future use in making changes in the BSCS programs for introducing the curriculum to teachers.

The actual instruction and field-testing of the experimental curriculum occurs at the end of this stage.

Stage 6, An Evaluation of the Field-Testing

An evaluation of the field-testing is conducted by teachers, observers, and the BSCS staff. This process is represented in Diagram 8. Input data from a variety of sources are analyzed in this evaluation. These data are (1) student records of performance, (2) student attitude measures, (3) questionnaires, (4) teacher ratings and reports, (5) daily classroom observers' ratings and reports, (6) student interviews, and (7) BSCS on-site visits. This information is broken down in the process of evaluating curriculum field-testing into the following subprocesses: (1) activities of the curriculum, (2) student performance, and (3) curriculum implementation.

An evaluation of the curriculum activities involves five major components: (1) the appropriateness of instructional objectives for each activity; (2) the clarity of directions for each activity, (3) the appropriateness of the curriculum content for

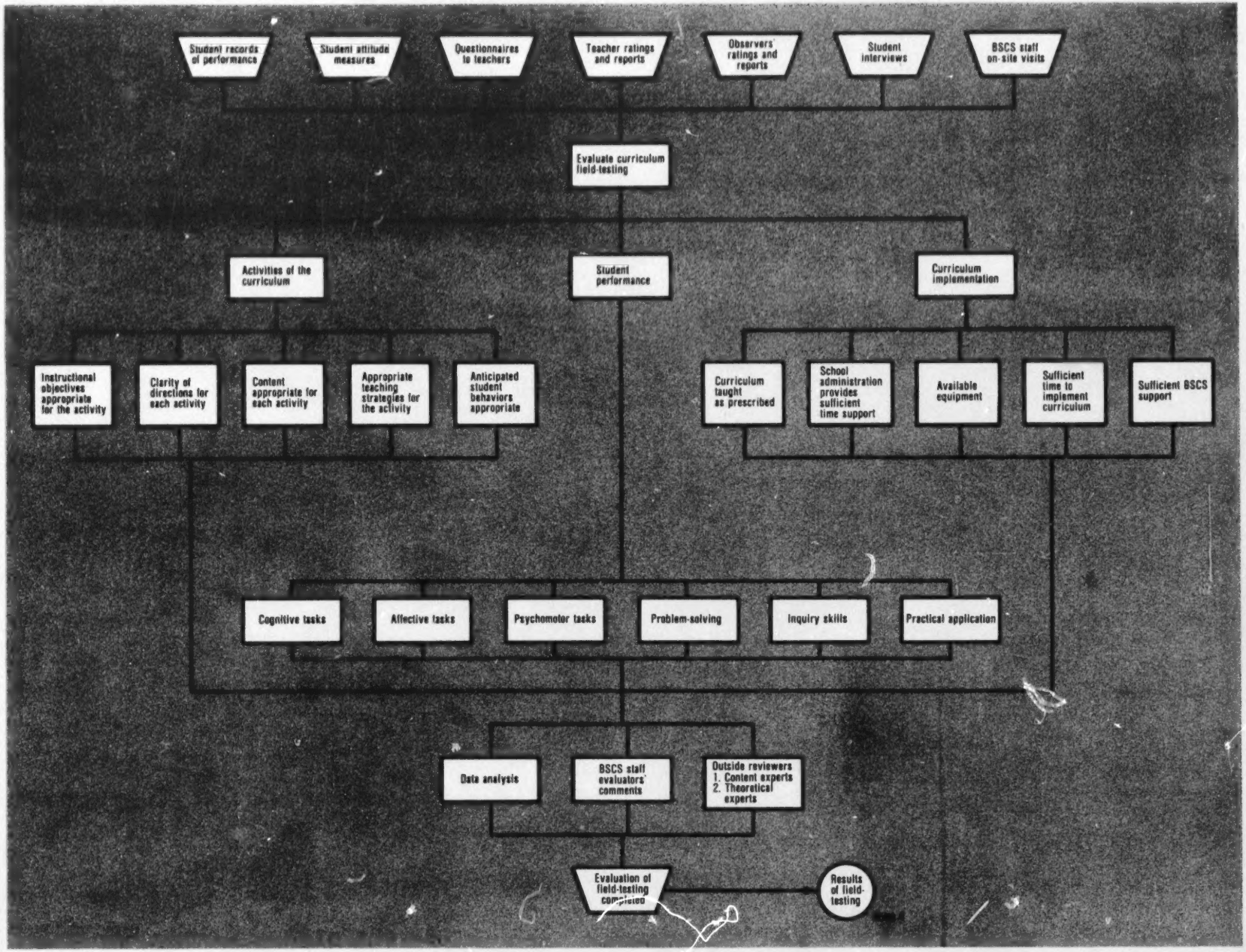
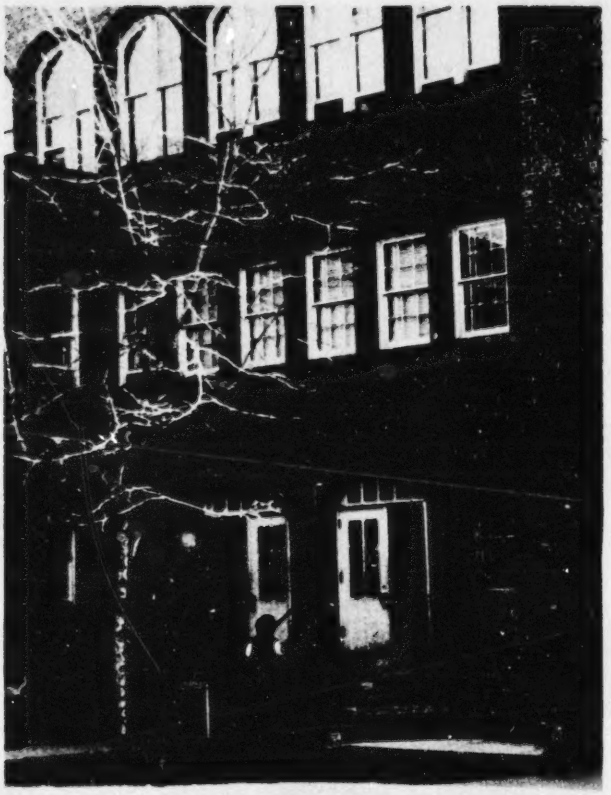


DIAGRAM 8 Stage 6, Evaluation of Field-Testing



each activity; (4) the appropriateness of teaching strategies for each activity; and (5) the appropriateness of anticipated student behaviors.

The process of evaluating the effectiveness of the curriculum involves the assessment of student performance in several different areas: (1) cognitive tasks, (2) affective tasks, (3) psychomotor tasks, (4) problem-solving abilities, (5) inquiry skills, and (6) the use of practical applications.

The evaluation of curriculum implementation consists of seeking answers to five major questions: (1) whether the curriculum is taught as prescribed, (2) whether the school administration provides sufficient time support, (3) whether support equipment is available, (4) whether sufficient time to implement the curriculum has been allowed, and (5) whether there is sufficient BSCS staff support.

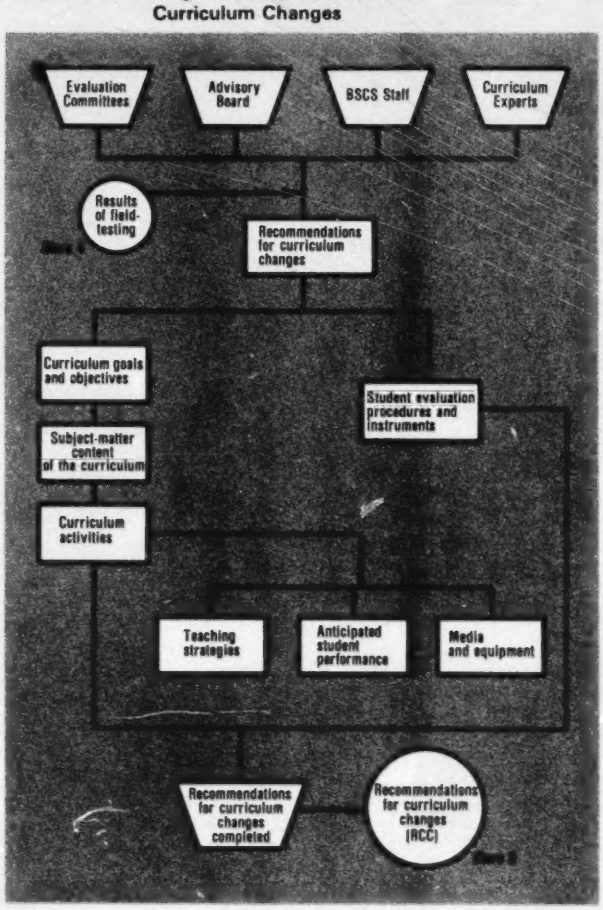
Information and data obtained from analyzing the activities of the curriculum, student performance, and curriculum implementation processes are evaluated from a formative evaluation approach. That is, evaluation of the effectiveness of the experimental curriculum is derived from informal and formal information and data gathered as an ongoing procedure. For example, the following sources of data are used: (1) teacher reports and comments, (2) student interviews and comments, and (3) results from performance tests. These field-testing data are evaluated by three major processes. (1) statistical analysis, (2) BSCS staff evaluators' comments, and (3) outside reviewers' comments. Upon completion of the field-testing evaluation, the results are stored (Store 4) and used in the compilations of curriculum changes to be made in Stage 7.

Stage 7, Compilation of Curriculum Changes to Be Made in the First Experimental Edition of the Curriculum

Upon completion of field-testing, a compilation of curriculum changes is formulated. This particular stage is represented in Diagram 9. Input for recommended curriculum changes is derived from the following sources: (1) evaluation committee members, (2) advisory board members, (3) BSCS staff, and (4) curriculum experts.

In addition, the results from the field-test evaluation (Store 4) are entered as input data in order to provide a framework for making curriculum changes. The process of making recommendations for curriculum changes consists of subprocesses related to curriculum orientation and evaluation design. Recommended curriculum orientation changes are analyzed in relation to the following elements: (1) curriculum goals and objectives, (2) subject-matter content of the curriculum, and (3) curriculum activities that involve teaching strategies, anticipated student performance, and media and equipment. The process of recommending changes in evaluative design is concerned with the revision of data-collecting instruments and evaluation procedures. Upon completion of gathering data related to recommended curriculum changes, the information is stored (Store 5) and used in the revision of the first experimental curriculum.

DIAGRAM 9 Stage 7, Compilation of Recommended Curriculum Changes



Stage 8, Second Revision of the Experimental Curriculum

The second revision of the curriculum follows a sequence similar to Stage 3. In addition, the stored information regarding recommendations for curriculum changes (Store 5) is introduced. Refer to Diagram 5 for further information.

Stage 9, Preparing a Second Group of Field-Test Teachers and Conducting Field Test II

Stage 9 is a repeat of Stage 5, with the addition of the changes derived from the first teacher orientation program (Store 3). Refer to Diagram 7 for further information.

Stage 10, Second Field-Test Evaluation of the Curriculum

This is a repeat of Stage 6, Evaluation of Field-Testing. Refer to Diagram 8 for further information.

Stage 11, Compilation of Changes to Be Made in the Second Edition of Experimental Materials

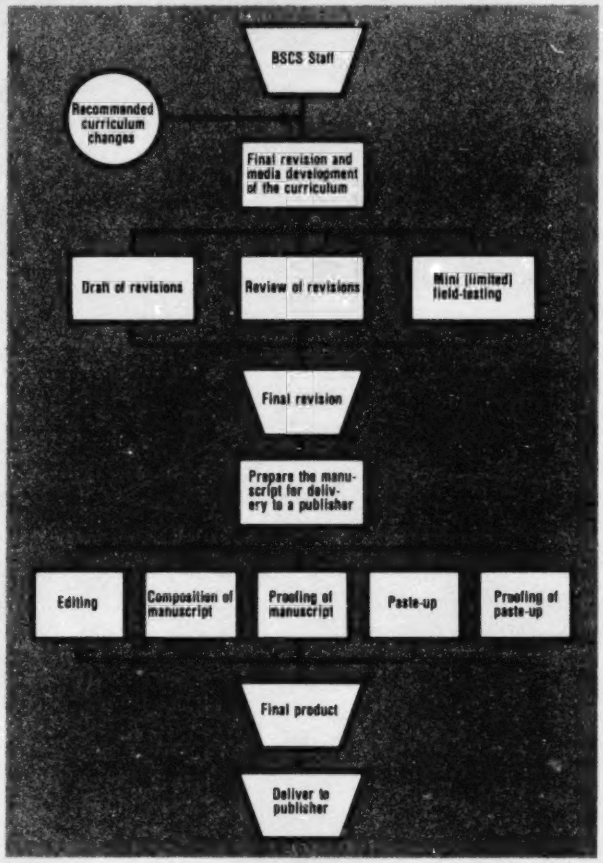
Repeat Stage 7. Refer to Diagram 9 for further information.

Stage 12, Final Curriculum Revisions

The subsystem concerned with the final revision of the curriculum is represented in Diagram 10. Usually it is the BSCS staff that is responsible for the final writing and media development of the curriculum. Input data are derived from the BSCS staff and the recommended curriculum changes obtained from Stage 11 (Store 5, Recommended Curriculum Changes). The final writing process involves a sequence of activities. These are: draft of revisions, review of revisions, and limited field-testing.

Upon completion of the final revision, preparing the curriculum for commercial publication takes the form of a series of processes. These processes are (1) editing, (2) composition of the manuscript, (3) proofing of the manuscript, (4) paste-up, and (5) proofing of paste-up. After these processes are completed, the curriculum is ready for commercial publication.

DIAGRAM 10 Stage 12, Final Revision and Media Development of the Curriculum



The systems approach provides a comprehensive view of the elements involved in designing and producing a curriculum. A primary attribute of the systems approach is that the components of curriculum development can be identified and the various parameters identified. Such an approach also provides a logical and sequential flow of activities.

summary and implications in brief

In summary, this Formative Evaluation Report reflects a positive response to the materials and activities considered. The evaluation items, teacher feedback, and reviewers' comments all indicate a general acceptance of the materials. Although several minor modifications in the curriculum were recommended, the body of knowledge was presented in a manner that was accepted by the teacher as accurate, as well as valuable to the student.

The students evaluated in the context of these materials were capable of achieving the objectives set forth, and in all but a few instances, at an acceptable level. In the instances where the level of performance was not acceptable, the reason was usually that there was a flaw in the construction of a test item, although the actual content and basic concepts were intact.

The substantial addition to, and modification of, certain sections of Unit 4 to include the *Anyone Can* game and the *I'm the Very First Link* filmstrip were discussed separately within this report.

The essential characteristics of the formative evaluation process are clearly demonstrated by the activities in curriculum development reported here. The systematic gathering of data for the purpose of improving ongoing activity and modifying curriculum content is shown to be a key element in material production. Perhaps *the* key element in the entire formative evaluation process is a system for collecting feedback and translating it into modified materials. With stable goals and objectives delineated, the ongoing modification of curricula, or delivery systems, is accomplished through such a feedback system of field-testing, student assessment, and the implementation of expert opinion on content and relevance.

Me and My Environment

ACKNOWLEDGMENTS

The development of a curriculum is the product of many people. We are indebted to the five members of our advisory board for wise counsel in the design and planning and completion of the program. Much of the creativity of the materials is due to the inspiration of the summer and staff writing teams. From the many reviewers came substantive ideas for modification. A number of evaluators contributed to the plans for data collection and analysis. The field-test teachers did yeoman service in providing the bulk of data for study. The insights of six observers further contributed to the richness of data collected. The analysis of materials and data from field tests has represented a joint effort of past and present staff consultants for the project. The contributions of the illustrations staff to every phase of program development goes often unrecognized, but represents a significant increase in the meaningfulness of all materials. A number of people have participated in writing this report through drafts, compilation of data, and editing. Particular acknowledgment is due Roy Gromme, George Clark, Nels Sorensen, Janet Mansfield, and John Tarp.

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Missoula, Montana

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Goleta, California

Dannette Fitzgerald
Nevin Platt Jr. High
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